AN ANALYSIS OF ESTABLISHING OPERATIONS FOR SELF-INJURIOUS BEHAVIOR MAINTAINED BY ESCAPE

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A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1994

ACKNOWLEDGEMENTS

I would like to thank the members of my committee, Marc Branch, Timothy Hackenberg, Dorothy Nevill, and Stephen Smith for their input and support during the preparation of this document. Thanks also go to faculty members Ed Malagodi, Henry Pennypacker, Elizabeth Capaldi, and Frans van Haaren for the roles they played throughout my education. Most profound appreciation is extended to Brian Iwata, whose professional supervision and support, personal counsel, and academic integrity provide a role model for the highest standards in education and research.

Several of my current and past colleagues have contributed to the current research in important ways. Han Goh and Bridget Shore were instrumental in developing and conducting these studies. Dorothy Lerman, Jodi Mazaleski, Sonya Ulrich, Iser DeLeon, and Sung Woo Kahng variously conducted sessions, collected and calculated data, and contributed helpful ideas. A special thank you goes to two wonderful friends and colleagues, Timothy Vollmer and Jennifer Zarcone. Thanks also to Cydney Yerushalmi for helping to set the occasion for my return to graduate school.

Finally, I dedicate this dissertation to my parents, Harry and Terry Smith. For their unconditional support and love (and profound patience) they deserve to share in this accomplishment.

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December, 1994

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Major Department: Psychology

Research has shown that self-injurious behavior (SIB) can be maintained through operant contingencies. Negative reinforcement of SIB typically involves its occurrence in the context of training or task requirements, which results in termination of those requirements. That is, by engaging in SIB, the individual effectively escapes the ongoing training or "demand" situation. Although several studies have demonstrated methods of assessing and treating SIB maintained by negative reinforcement, few component analyses of the establishing operations associated with demand situations have been conducted, and no studies have articulated a generic method for examining these properties. The current series of studies demonstrated a method for identifying features of the demand context that may serve as establishing operations by systematically altering dimensions of the demand situation while maintaining an escape contingency for SIB. Dimensions assessed in the

current study included task novelty, duration of instructional sessions, and rate of task presentation. Data are presented indicating that these variables can have establishing properties for behavior maintained by escape. Implications of the results are discussed, as are potential refinements and extensions of the assessment procedures

INTRODUCTION

Self-injurious Behavior

Self injurious behavior (SIB) is a dramatic and bizarre behavior disorder that is often seen in persons with developmental disabilities. SIB is characterized by a wide range of response topographies, including head banging and hitting, hitting other body parts, self-biting, mouthing hands or objects, pica (ingesting inedible objects), eye gouging, rumination (regurgitating and reswallowing food), scratching, trichotillomania (hair pulling), and others (Maurice & Trudel, 1982). The common outcomes of these diverse behaviors provide a basis for the widely accepted definition of SIB as any response that "produces physical injury to the individual's own body." (Tate & Baroff, 1966, p. 281). Thus, SIB infers no particular etiology but is rather a descriptive label derived solely from consequences involving tissue damage to the behaver.

Although no thorough studies of the prevalence of SIB are currently available, one survey estimated that approximately 14% of an institutionalized developmentally disabled population exhibits some form of SIB (Griffin, Williams, Stark, Altmeyer, & Mason, 1986). SIB also has been observed to occur in normal infants; however, both the prevalence and the severity of SIB is lower in normal infants than in developmentally disabled persons (DeLissovoy, 1961).

Explanations for the causes of SIB have ranged from psychotic self punishment (Dubrowski, 1937) to involuntary psychomotor activity (Gedye, 1989). Most current

account of SIB emphasize biological and operant mechanisms of control. Several medical disorders, including Lesch-Nyhan syndrome (Nyhan, 1976), Cornelia de Lange syndrome (Bryson, Sakati, Nyhan, & Fish, 1971), and otitis media (ear infection) (DeLissovoy, 1963) have been shown to be correlated with a high prevalence of SIB, suggesting an organic or biological basis for SIB in persons presenting with these medical diagnoses. However, most SIB is not associated with identifiable biological factors, and research has shown that SIB associated with a medical condition may continue to occur even after successful treatment of the medical problem (Carr & McDowell, 1980). Thus, although evidence suggests that biological factors may be involved in the etiology of SIB for some individuals, other factors must account for the occurrence of SIB in individuals who have no associated medical diagnosis, or for SIB that continues to occur following treatment for an associated medical condition.

Much current research focuses on operant accounts of the mechanisms underlying SIB. Operant theory holds that most human behavior (including SIB and other aberrant behavior) occurs as a function of environmental antecedents and consequences. Over the past two decades, assessment and treatment methods based on operant theory have become increasingly representative of research on SIB, as well as autistic behavior, stereotypy, aggression, and other behavior disorders (Matson & Frame, 1986). The development and significance of operant accounts of SIB and other behavior disorders, and of an assessment technology based upon this account, is described next.

An Operant Framework for Self-Injury and other Behavior Disorders

Early treatments based on operant accounts of behavior disorders typically did not include consideration of the variables that set the occasion for and maintained the occurrence of those problem behaviors (However, see Carr, Newsom, & Binkoff, 1976;

Lovaas, Freitag, Gold, & Kassorla, 1965, Lovaas & Simmons, 1969 for exceptions). Initially, behavioral treatments were characterized by the use of behavioral procedures designed to reinforce appropriate behavior (e.g., differential reinforcement procedures) or to punish inappropriate behavior (e.g., contingent aversive stimulation, response cost, and time-out) and were effective only to the extent that they "overrode" the variables of which problem behavior was normally a function.

By the end of the 1970s and into the 1980s, applied researchers began to articulate and study the environmental variables thought to be associated with SIB and other behavior disorders. Carr (1977) summarized several hypotheses about the variables maintaining SIB, including positive and negative reinforcement accounts, and one based on the concept of "self-stimulation." The positive reinforcement hypothesis held that SIB may be maintained by the contingent presentation of attention from caregivers, preferred activities, or access to tangible reinforcers. The negative reinforcement hypothesis held that maladaptive behavior may be maintained by the contingent termination or avoidance of events such as instructional trials, the presence of noisy peers, or other socially mediated stimulation. The self-stimulation hypothesis held that SIB may be maintained by its sensory consequences such as tactile, auditory, or visual stimulation.

Iwata, Dorsey, Slifer, Bauman, and Richman (1982) developed a method for assessing the relationship between SIB and environmental contingencies in individual subjects. In a "Social disapproval" condition designed to identify SIB maintained by positive reinforcement, therapists provided statements of concern and disapproval following self-injurious responses. In an "Academic demand" condition designed to identify SIB maintained by negative reinforcement, therapists presented task demand trials, and the consequence for SIB was a brief period of escape. An "Alone" condition simulated a barren environment with no access to social stimulation, and was designed to test for self-stimulatory behavior. A control condition, simulating an enriched environment in

which SIB would be unlikely to occur according to operant accounts, also was conducted. The results of this study provided support for each of these accounts of self-injurious behavior, suggesting that the SIB of these subjects occurred as a function of operant contingencies whose functional properties varied across individuals. Subsequent research has replicated and extended this functional analysis approach across a wide range of aberrant behaviors, settings, and methodological variations, and has shown that the outcomes of such assessments have direct implications for treatments based on behavioral function (see Iwata, Vollmer, & Zarcone, 1991, and Mace, Lalli, & Pinter-Lalli, 1991, for reviews).

Most of the research on functional analysis has concentrated on the consequences that maintain maladaptive behaviors. However, recent research trends indicate an increasing interest in the antecedent conditions associated with behavior disorders (e.g., Carr & Durand, 1985; Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991; Durand & Crimmins, 1987, 1988; Mace & West, 1986). These studies have attempted to identify, and often to manipulate as treatment, antecedent conditions that set the occasion for maladaptive behaviors.

A behavioral account of the functional properties of antecedent conditions may be classified according to two fundamental relations. First, discriminative conditions are stimulus conditions that are differentially correlated with a contingency between a specific response and a specific consequence (Skinner, 1953). Such conditions acquire evocative or suppressive properties relative to that response as a function of this special relationship with the response and its consequences. For example, if a stimulus condition is differentially correlated with the availability of powerful reinforcement contingent upon a specific response, then that response will be more likely to occur in the presence of that stimulus condition than in its absence. Similarly, if a stimulus condition is differentially correlated with the presentation of aversive consequences contingent upon a specific

response, then that response will be less likely to occur in the presence of that stimulus condition than in its absence.

A second fundamental relation among antecedent conditions, behavior, and consequences is the establishing operation (Michael, 1982), which alters the reinforcing effectiveness of specific consequences, and thus alters the probability of the occurrence of behaviors that have previously produced those consequences. Thus, in the presence of stimuli that are discriminative for a specific consequence contingent upon a specific response, the probability of the occurrence of that response may be mediated by establishing operations that increase or decrease the reinforcing effectiveness of that consequence.

Although research has begun to investigate antecedent events associated with behavior disorders, few studies have attempted to classify these conditions according to fundamental behavioral properties, and no general methodology for a functional analysis of antecedents has emerged. It is difficult to investigate discriminative operations using solely antecedent-based procedures because discriminative control requires the maintenance of correlations between antecedent stimuli and the availability of reinforcement. Thus, studies on stimulus control must arrange either to maintain or establish discriminative control by manipulating both both antecedents and consequences. On the other hand, establishing operations do not derive their functional properties due to differential reinforcement contingencies, and thus, it may be possible to study their effects using procedures that involve only antecedent manipulations. The next section describes the functional properties of the establishing operation in greater detail, thus setting the conceptual framework for a review of studies relevant to establishing operations in escape-maintained behavior disorders as well as for the current series of studies.

Establishing Operations

Operant theory, based largely on the work of B F Skinner, has developed a relatively comprehensive account of the behavior of organisms, with a classification system of principles based upon relationships and interactions between environmental variables and behavior For example, the principle of reinforcement is defined by a relationship between behavior and its consequences in which a contingent relationship between specific responses and consequences increases the future probability that similar responses will occur However issues relating to antecedent events that motivate behavior have long been topics for debate among behavior analysts Behavioral theorists have yet to establish a consensus on how best (or, indeed, *whether*) to classify motivational events, as evidenced by a recent discussion article on this topic (Michael,1993b) and commentaries on that article (Catania 1993 Hesse, 1993, McDevitt & Fantino, 1993 Schlinger, 1993, Sundberg, 1993)

Skinner's treatment of motivational events provides a basis for a functional definition of motivational variables He offered separate but similar accounts of the influences of deprivation and satiation, emotional stimulation, and other apparently motivational events, however he did not abstract from these similar accounts a behavioral principle based upon shared functional properties For example, Skinner asserted that the primary effect of deprivation from a specific reinforcer is that operant behavior maintained by that reinforcer will be emitted at the first opportunity (Skinner, 1953) Thus, food deprivation will increase the probability that responses resulting in access to food will occur, and similar effects may occur when organisms are deprived of water, exercise, social interaction, sexual activity, and other reinforcers Satiation of these reinforcers, on the other hand, results in a decrement in responses maintained by their contingent presentation.

Emotional variables were described by Skinner to have similar effects. Skinner defined "emotion" as "a particular state of strength or weakness in one or more responses induced by any one of a class of operations" (Skinner, 1953, p. 166). Emotions shared the common characteristics of induction by environmental events, association with reflex responses (e.g. elevated heart rate, etc.), and alteration of the frequency of behaviors sharing common consequences. Thus, like deprivation and satiation, a primary effect of emotional stimulation is to alter the probability of responses associated with particular maintaining variables.

Skinner also discussed other variables with similar behavioral effects. For example, behavior maintained by access to water may be increased by such manipulations as the induction of sweating through exercise or the introduction of heat, salt ingestion resulting in increased excretion of fluids, or the loss of blood. Again, the effects of such events, like those of deprivation, satiation, and emotional stimulation, is to alter the likelihood that behaviors maintained by common consequences will occur.

A final class of events with apparent motivational properties is aversive stimulation. Skinner defined aversive stimulation in terms of several behavioral effects, including the power to strengthen behavior that results in its contingent withdrawal, postponement, or reduction. The process by which responses are thus maintained is called negative reinforcement (as opposed to positive reinforcement, in which responses are strengthened when they result in the contingent *presentation* of a stimulus). Like deprivation, satiation, emotional stimulation, and other related events, aversive stimulation changes the probability that responses maintained by particular consequences (in this case, offset, reduction, or postponement of the stimulus) will occur.

Although Skinner acknowledged the similar behavioral effects of these otherwise disparate events, he did not propose a common behavioral principle to describe these effects. J. R. Kantor introduced a theoretical system that ostensibly accounted for

complexities in human behavior beyond those considered in Skinner's account (Kantor 1959, 1981). Kantor shared some basic assumptions with behaviorists, yet he also criticized behavior analysts for limitations in the scope of their study. He asserted that the customary methods of behavior analysis could not extend to complex human behavior and proposed concepts such as 'behavioral fields" and "setting factors" to capture the interactive and elaborate nature of the relationship between environment and behavior (Kantor, 1970, p. 105).

Setting factors or setting events, were described as antecedent (and concurrent) factors whose influence extended apart from those of simple, discrete stimulus events. Some of these setting events include conditions of deprivation and satiation as well as "the hygiene of the organism, its habituation or past behavioral history, what behavioral circumstances it has recently or just previously passed through, the presence or absence of confining objects, and numerous others. In human situations, of course, there are such circumstances as rivalry, compliance, and competition, as well as the unique needs and desires of the behaving individual." (Kantor, 1970, p. 107). Thus, Kantor introduced a term for classifying disparate influences on behavior, many of which seemed to have motivational properties. This classification system has influenced some applied behavior analysts interested in the effects of antecedent variables. For example, Wahler has developed a general method for incorporating setting variables in applied research (Wahler, 1980, Wahler & Fox, 1981), which has been adopted by several researchers interested in the analysis and treatment of behavior disorders (e.g., Kennedy & Itkonen, 1993, Schroeder, Kanoy, Mulick, Rojahn, Thios, & Stephens, 1982).

Although Kantor's concept of the setting event provides an umbrella term for a range of antecedent influences over behavior, it lacks a functional basis for inclusionary criteria. That is, the behavioral mechanisms by which setting events have their influence are not specified in Kantor's account, these events may exert stimulus control over behavior, or

they may be motivating influences, or both. Setting events are most often described according to structural features, including their temporal relationship with behavior (e.g., they occur antecedent to or concurrent with behavior; they may or may not occur contiguously with behavior) and/or their physical dimensions (e.g., they may occur physically distant from the behavior they ultimately affect), rather than according to basic behavioral relations. Whereas Skinner's classification system did not include a category for events commonly viewed as motivational, Kantor's system offered a classification system that included those events but that did so without specifying their basic behavioral properties. Thus, regardless of how one views or defines classes of antecedent events (using either Skinner's or Kantor's nomenclature), the functional properties of these events require further analysis.

Keller and Schoenfeld (1950), and, more recently, Michael (Michael, 1982, 1983, 1988, 1993a, 1993b) articulated the functional and formal characteristics of a class of variables called "establishing operations." Defined as a variable that momentarily alters the reinforcing effectiveness of some other object or event (Keller & Schoenfeld, 1950), the establishing operation provides a framework for classifying the effects of many formally disparate variables that share common functional properties.

The above definition imposes only one structural restriction on the establishing operation, that of momentary effects. Thus, establishing operations may account for a wide range of events whose effects are motivational in nature. They do not derive their functional properties through prior pairings with reinforcer availability as do discriminative stimuli, rather, their effects are to increase or decrease the effectiveness of consequences as reinforcers, and thus to alter the probability of responses that have previously been reinforced by these consequences. These effects are, in turn, mediated by the presence of other establishing and discriminative conditions.

Perhaps the most obvious example of an establishing operation is seen in the effects of deprivation on appetitive behavior. As described by Skinner (1953), the effects of water deprivation are (a) to increase the probability of water consumption upon the first opportunity and (b) to strengthen all conditioned and unconditioned responses associated with water consumption. These are the defining characteristics of an establishing operation.

Another example of establishing operations concerns emotional stimulation. As previously noted, Skinner viewed emotion as "a particular strength or weakness in one or more responses induced by any one of a class of operations" (Skinner, 1953, p. 166). Further, the concept of the emotion contained three defining characteristics: (a) induction via environmental stimulation, (b) the simultaneous occurrence of reflex responses, and (c) an alteration in the probability of a class of behaviors distinguished by a common consequence. It is the third feature of emotions that places them directly in the realm of establishing operations. That is, they (a) momentarily alter the effectiveness of certain forms of reinforcement, and (b) alter the frequency of conditioned and unconditioned responses associated with those reinforcers. The 'felt" aspects of the emotional event are considered, as in Skinner's account, covariants with, rather than causes of emotional behavior.

Other operations having effects similar to those of deprivation but with disparate formal characteristics (e.g., the effects of salt ingestion, blood loss, or perspiration on drinking; of aphrodisiacs on sexual behavior; of psychoactive drugs in general) all were discussed in terms of "motivation," however. Skinner did not articulate a common environment-behavior relationship underlying these similar effects. The concept of the establishing operation provides a framework for functional unity among these widely varied events.

One of the effects of aversive stimulation also is best described as an establishing operation. As previously discussed, aversive stimulation will produce an increase in the probability of behavior previously reinforced through the termination of such stimulation. Although some have argued for a stimulus control account of aversive stimulation (i.e., that aversive stimulation is a discriminative stimulus for escape responses) (Carr, Newsom, & Binkoff, 1976; Touchette, MacDonald, & Langer, 1985), Michael pointed out two important differences that favor an interpretation based on establishing operations.

First, discriminative stimuli acquire their evocative functions through correlations with the availability of certain consequences contingent upon certain responses. The occurrence of aversive stimulation, however, is not necessarily correlated with the availability of contingent escape. Michael very aptly states the case: "Being in pain is not systematically correlated with being able to remove pain, sad but true, except in the sense that if there were no pain there would be no pain to remove. In other words, the presence of pain is a necessary, but not sufficient condition for its removal...just as food or water deprivation is necessary but not sufficient for food or water reinforcement. . . . Just because an organism is hungry doesn't mean that food is likely to be available, as would be pointed out by many currently hungry organisms. Similarly with painful stimulation. It is not differentially correlated with the availability of some way to reduce the pain." (Michael, 1988, p. 4.)

The second difference between aversive stimulation and stimulus control is that there is no sense in which extinction in the absence of a discriminative stimulus is analogous to the failure of escape responses to produce escape in the absence of aversive stimulation. That is, in the absence of a discriminative stimulus the presentation of food would nevertheless be a reinforcing event for a food-deprived organism; observed reductions in responding are thus attributed to extinction due to reinforcement unavailability. However, in the absence of aversive stimulation it is not possible to attribute observed reductions in escape-related responses to the extinction of those responses due to their failure to produce

escape. Presentation of food has no reinforcing function for the satiated organism; similarly, the absence of aversive stimulation as a consequence will not maintain responding in the absence of (at least a history of) antecedent aversive stimulation. Thus, the absence of aversive stimulation is more similar to the absence of food deprivation than to the absence of a discriminative stimulus.

In addition to unconditioned, or unlearned establishing operations such as deprivation and aversive stimulation, Michael also has proposed several conditioned establishing operations in which stimuli acquire their behavior-altering properties due to learning mechanisms (Michael, 1993a). Although empirical evidence supporting these operations is minimal or equivocal, they represent extensions of the concept of establishing operations based upon conditioning principles. Thus, each will briefly be considered here.

First, the surrogate conditioned establishing operation is said to acquire evocative properties similar to those of existing establishing events through pairings with those events. That is, the surrogate conditioned establishing operation alters the efficacy of the form of reinforcement associated with the original establishing operation and also alters the frequency of behaviors maintained by that form of reinforcement.

Second, the reflexive conditioned establishing operation is held to be correlated with the overall worsening or improvement of a situation. When stimuli are correlated with worsening, the situation is typically referred to as discriminated avoidance. However, given Michael's treatment of negative reinforcement (i.e., the onset of aversive stimulation is an establishing operation for its own offset), it seems consistent to interpret responding evoked by a "warning" stimulus and maintained by the termination of that stimulus in terms of establishment. Thus, "conditioned aversive stimuli" constitute, for Michael, conditioned establishing stimuli. Stimuli that are negatively correlated with improvement also will come to establish their termination as a reinforcing event. Similarly, a stimulus that typically precedes an improvement in an organism's situation, or that is negatively correlated with

worsening (i.e., a ' safety signal ') will suppress responses associated with its termination, as well as reinforcing responses that produces it. Michael notes that, for the above relationships to hold, termination of the stimulus must systematically prevent worsening or improvement, if this relationship is broken, then conditioning of the establishing operation also will break down. Critics may have solid foundation for asserting that this correlation with the ultimate availability of reinforcement places such an operation in the class of discriminative, rather than establishing events. It may be that multiple stimulus functions occur in cases in which stimuli are correlated with certain outcomes and also set the occasion for responses that will result either in their offset or their continuation.

Third, the transitive conditioned establishing operation is correlated with conditional conditioned reinforcement or punishment. This conditioned establishing operation occurs "when a stimulus condition (S1) is correlated with the correlation between another stimulus (S2) and some form of improvement (or worsening), the presence of the S1 establishes the reinforcing (or punishing) effectiveness of S2, and evokes (or suppresses) the behavior that has been followed by that reinforcement or punishment" (Michael, 1993a, p. 70). As with other conditioned establishing relations, basic research on this relation is equivocal, but in this case, Michael offers a compelling example from human behavior:

> A workman is disassembling a piece of equipment. His assistant hands him tools as he requests them. In the process of disassembling he encounters a slotted screw which must be removed, and requests a screw driver. The sight of the screw evoked the request, the reinforcement for which is receiving the screw driver. To refer to the slotted screw as an S^D for the request however raises the difficulty. This stimulus has not been differentially correlated with successful requests – screw drivers are not more available when slotted screws are around, but rather more valuable. The slotted screw should be considered a CEO for the request, not an S^D. In its presence screw drivers have been correlated with successful disassembly and are therefore valuable. (Michael, 1993a, p. 71).

This relationship, originally called the "blocked response establishing operation," provides a clear example of "context" effects in motivating behavior maintained by conditioned reinforcement.

The concept of the establishing operation provides a basis for classifying the behavioral effects of seemingly disparate events according to shared functional properties. That is, the behavioral effects of deprivation and satiation, emotions, antecedent aversive stimulation, and certain other antecedent events all may be described according to a common process whereby these events alter the reinforcing effectiveness of certain reinforcers, and thus also alter the likelihood that behavior maintained by those reinforcers will occur. These effects may be distinguished from those of discriminative stimuli, which alter the likelihood of behavior because they are differentially correlated with specific behavior-consequence contingencies.

The importance of understanding the relationship between establishing operations when assessing and treating SIB and other behavior disorders has not been extensively studied or discussed. However, the recognition by some researchers that a technology based upon the manipulation of antecedent events represents a "proactive" advance beyond current treatment practices (Touchette, MacDonald, & Langer, 1985) suggests that further investigation of establishing events for behavior disorders may lead to more effective intervention methods.

The role of establishing operations in negatively reinforced behavior problems is especially promising as a topic for research, because a high degree of control over the relevant variables may be possible. That is, because the events that establish socially mediated escape as a reinforcing consequence are themselves socially mediated (i.e., because these events almost always are both presented and withdrawn by teachers, parents, or other caregivers), direct manipulation of these events is possible. Thus, if sufficient control over other variables is exercised, it may be possible to examine directly various aspects of events that establish their own termination as a reinforcing outcome, possibly leading to advances in our basic understanding of such processes, as well as promoting the development of more effective methods for assessing and treating behavior problems maintained by escape. In the next section, research relevant to the assessment and

manipulation of the events that establish escape as a reinforcer for individuals with behavior disorders maintained by negative reinforcement is reviewed.

Functional Analysis of Antecedent Events in Behavior Disorders

An emerging body of research has as its focus events that occur antecedent to maladaptive behaviors. At least three approaches to the analysis of antecedent events can be distinguished, including ecological assessments of setting events (e.g., Berkson & Davenport, 1962; Byou, Peterson, & Ault, 1968; Davenport & Berkson, 1963; Wahler & Fox, 1981), functional assessments that manipulate only (or primarily) antecedent variables (e.g., Carr & Durand, 1985; Durand & Carr, 1987, 1992; Durand & Crimmins, 1987, 1988), and studies that manipulate both antecedent variables and consequences to assess maladaptive behavior (e.g., Iwata et al., 1982). These approaches, and their relevance for an analysis of establishing operations in behavior disorders (especially those maintained by social negative reinforcement), are discussed below.

As an example of the assessment of setting factors in maladaptive behavior, Schroeder et al. (1982) performed an ecological assessment of conditions related to problem behavior in a program for the treatment of SIB. Data were collected using "ecological interval recording," a modification of a procedure described by Wahler, Stambaugh, and House (1976) in which categories of target behaviors, general behavior, social responses, social stimulation by staff, and environmental stimulation were scored using a 10-s interval procedure. Functional relationships among these variables were inferred through correlational data, and inferential statistics were used to determine significance of effects. Results indicated that the pace of staff-initiated interactions, presence of a disruptive client, time of day, staff-client ratio, presence of "self protective devices," and presence of toys all were correlated with SIB, as well as with other

maladaptive behaviors. Although these findings suggest relationships between ecological variables and target behaviors, they may not represent the functional relationships affecting the behavior of individuals. Inferential statistics provide a picture of an "average" client; however, they may not provide insight into the behavior of any given client (i.e., no "average client" may exist). Further, the identification of molar relationships may not reveal--or may even obscure--the variables that are functionally related with target behaviors. For example, Schroeder et al. identified a correlation between time of day and maladaptive behavior; however, it is unlikely that this variable was directly relevant in evoking or maintaining problem behavior. Rather, some other correlated variable(s), such as medication regimes, activity or meal schedules, staffing shift changes, or other temporally correlated events may have been relevant. Finally, this method does not permit analysis of the functional relationships involved, even if relevant conditions can be identified. That is, although it may be the case that the presence of a disruptive client increases the likelihood of SIB in certain clients, the mechanisms underlying this relationship are not apparent. The disruptive client may annoy other clients, establishing escape from the presence of that client as a reinforcer. Alternatively, if caregivers disproportionally attend to disruptive clients, then disruptive behavior by one client may be discriminative for the availability of attention for the maladaptive behavior of another client. Thus, inferences about establishing, discriminative, or maintaining variables are limited due to lack of control over potentially important variables.

In another assessment of setting factors, Repp, Singh, Karsh, and Deitz (1991) examined relationships among several combinations of settings and task requirements on the stereotypy of 12 subjects with developmental disabilities. Data were examined both within and across subjects. Group data revealed correlations between demand conditions and stereotypy (increases in stereotypy were associated with both "overt" and "covert" demand conditions relative to no demand conditions). However, individual subject data

showed idiosyncratic correlations between stereotypy and environmental antecedents, and the relationships revealed by several subjects' data were opposite to those reported for the group. This finding again highlights a limitation of the group design -- that aggregate data may not represent individual behavior. Further identification of the behavioral mechanisms underlying stereotypy was not possible even though data were collected on individual behavior. For example, although increases in stereotypy in the presence of demands may suggest that stereotypy was maintained by escape from demands, such increases also would occur if the presence of demands was discriminative for additional attention (e.g., additional prompting from the trainer) contingent upon stereotypy (Vollmer, Iwata, Smith, & Rodgers, 1992), among other possibilities. The authors were appropriately cautious, stating that "these data suggest that the functional relationship between maladaptive behaviour and environmental events may have to be assessed at a much greater molecular level than has been the case in the past to ensure appropriate and effective intervention" (p. 426). Thus, it is recognized that this observational method permits only an initial search for potentially relevant variables, and that greater control is required to analyze functional relationships (such as establishing operations) underlying correlations between environmental events and behavior.

Berkson and Mason (1963) manipulated molar variables in their assessment of antecedents, placing their subjects in several settings (the dayroom and dining area of the subjects' residence, a hospital room, a barren room, and an outdoor playground) and measuring levels of stereotypy, self-manipulation, environment-manipulation, and locomotion. Finding that stereotypy and self-manipulation occurred at higher levels in a novel, restricted environment than in familiar contexts in which alternative activities, such as manipulation of the environment and locomotion, were possible, the authors suggested that stereotypy and self-manipulation were "self-stimulation," reinforced by their sensory consequences. However, because only "context" was controlled, the strength of this

interpretation is limited. That is, because the consequences for stereotypy and self-manipulation may have varied systematically across the experimental situations, it cannot be determined that contextual differences per se controlled these responses. Also, because "context" in this study may be comprised of relationships among broad classes of antecedent, response, and consequence variables, it is not possible to distinguish reinforcer-establishing events from discriminative, or even irrelevant variables.

Some recent studies have begun to manipulate, as well as assess, setting events to reduce maladaptive behaviors. Kennedy and Itkonen (1993) performed "setting-event analyses" of the maladaptive behaviors of two female students with developmental disabilities. For one student, problem behavior later at school was correlated with awakening late; for the other student behavior problems at school were correlated with the use of a city street route versus a highway route on the way to school. Eliminating these setting events resulted in decreases in maladaptive behavior for both students, however, in each case the behavioral operations involved in these decreases remain unclear. Because the consequences maintaining problem behavior were not assessed (although problem behavior was observed to occur under some specific local conditions [e.g., during transitions between activities at school for one subject; following several bus stops for the other subject], no systematic attempt to identify maintaining variables occurred), it is not possible to determine the discriminative or establishing functions of the setting events. Further, it is possible that the setting events that were correlated with maladaptive behavior had no direct influence on those behaviors. Possibly, these events initiated a long and complex chain of environment-behavior interactions - including both establishing and discriminative events - that eventually occasioned the relevant response, as well as an unknown reinforcing consequence. For example, correlations between the setting events and other environmental events were noted (e.g., awakening late was correlated with missing breakfast, requiring assistance with dressing, and sleeping on the way to school, city route to school was correlated with frequent stops of the bus), however, these events

were neither controlled nor monitored throughout the study, so it is not possible to determine their relevance to behavior. Thus, the significance of events identified as covariants with problem behaviors is unknown. The authors recommend that "future research should more stringently control for immediate antecedents and consequences that occur along with problem behavior to avoid possible confounding effects among events. Also, the need to ascertain directly the positively and/or negatively reinforcing consequences that maintain behavior and the relation of the setting event to the maintaining variable(s) is critical" (p. 327).

Some experimental analyses have focused on antecedent variables to identify maintaining contingencies. For example, Carr et al. (1976) investigated the effects of mands from trainers on their subject's SIB. Although SIB did not terminate task requirements, mands per se evoked high rates of SIB. Comparison conditions consisted of free-time activities and a condition in which the therapist presented simple declarative statements (facts) to control for the general effects of therapist verbalizations. SIB almost never occurred in these latter conditions. The finding that SIB maintained at high rates in the mand condition is somewhat surprising, given that it did not result in escape. That is, although escape was not available as a consequence, mands continued to evoke SIB. Thus, an interpretation based upon an escape function for SIB is somewhat limited (it is possible that mands were discriminative for increased attention in the form of assistance contingent upon SIB).

In an interesting addition to the above study, four mand sessions were conducted in which a "marker stimulus" was presented at the end of the session. In one condition, the therapist said "O.K., let's go," a statement previously correlated with session termination. In a second condition, the therapist said "The sky is blue," a statement that had never previously occurred at the end of sessions. Observers continued to record data for one minute following the marker stimulus. Results showed that SIB decreased to zero in the

"O K. let's go ' condition but continued to occur during the one minute interval in the "The sky is blue" condition. This is similar to the case described by Michael as the reflexive conditioned establishing operation. The occurrence of the "O.K., let's go" stimulus is correlated with improvement, and thus responses that may interfere with improvement are suppressed. Alternatively, "O K , let's go" may simply be discriminative for the absence of further aversive stimulation, and negatively reinforced behavior may thus be decreased.

Durand and his colleagues have conducted a series of studies in which experimental analyses involve the manipulation of antecedent conditions exclusively (Carr & Durand, 1985; Durand & Carr, 1987, 1992; Durand & Crimmins, 1987, 1988). In this assessment paradigm, different arrangements of antecedent conditions associated with hypothesized functions of maladaptive behavior are compared; however, the hypothesized maintaining reinforcers are not presented as consequences for maladaptive behavior. This assessment methodology is pertinent to the current discussion because it is based upon manipulations of putative establishing operations to reveal the functional properties of maladaptive behavior. In a representative example of this procedure (Durand & Carr, 1987), an assessment of the "self-stimulatory" behavior (body rocking and hand flapping) of two developmentally disabled children was comprised of three conditions, sessions in each condition were 10-min in duration, and were divided into 60, 10-s intervals. In the baseline condition, easy tasks (identified previously as tasks that occasioned 100% correct responses) were presented, and prompts to complete these tasks were issued approximately every 30-s, or during 33% of intervals. A variable ratio 3 (VR 3) schedule of social reinforcement for correct responses resulted in the occurrence of praise approximately every 30-s, or during 33% of intervals. Presumably neutral comments were delivered in the remainder of intervals, resulting in the presentation of some form of attention from therapists in 100% of intervals during baseline. Baseline served as a control condition,

attention-maintained target behaviors would not be expected to occur due to the abolition of attention as reinforcement via attention, and target behaviors maintained by escape also would not be evoked because of the "easy" nature of the tasks.

The Attention condition was designed to assess whether the subjects' target behaviors were maintained by attention from adults. Tasks and the total amount of attention delivered were identical to baseline. However, in this condition the temporal distribution of attention was changed from 100% to 33% of intervals. Thus, approximately every 30-s the trainer presented a task demand, praise, and a neutral comment. The presumed establishing effects of the absence of social interaction during 66% of intervals was expected to evoke behavior maintained by contingent attention.

The Demand condition assessed the effects of a more difficult task on challenging behavior. The experimental arrangement was essentially the same as in baseline; however, tasks were selected for which the individual previously exhibited approximately 25% correct responses. The increased level of difficulty in this condition was expected to establish the reinforcing effectiveness of escape, and to evoke behavior thus maintained.

Results of the experiment showed low rates of target behaviors in baseline and attention conditions and higher rates of target behaviors during demand conditions for both subjects. The authors interpreted these results as suggesting that difficult tasks evoked target behaviors because the behaviors served an escape function (i.e., difficult tasks were establishing events for escape). The success of treatments based upon these findings provided further support for this interpretation. Other studies by this research group have produced results suggesting that relationships between maladaptive behavior and adult attention, the presentation of tangible items, and sensory reinforcement also may be assessed (Carr & Durand, 1985, Durand & Carr, 1992, Durand & Crimmins, 1987, 1988).

Although Durand and his colleagues report positive outcomes using this method of assessment, the conceptual bases for its success are not clear. Most difficult to explain is how behavior is maintained by providing antecedents presumed to evoke, but not consequences presumed to reinforce, maladaptive behavior. It would seem that extinction should occur in all cases except that of a sensory function. That is, although establishing operations may remain in effect during the various assessment conditions, behavior should come under control of stimulus conditions that are discriminative for the *absence* of an effective response (this limitation is shared by the previously described study by Carr et al., 1976). Perhaps the brevity of conditions (conditions are typically conducted for 3 sessions) limits extinction effects, however, this assessment is not based on contingencies of reinforcement, and its ability to differentiate behavioral function through fine-grained manipulations of establishing operations in the absence of maintaining consequences is inconsistent with established principles of behavior.

Other researchers have attempted to manipulate experimentally both specific antecedents and associated consequences to assess their effects on maladaptive behavior. The functional analysis methodology described previously (Iwata et al., 1982) is an example. Although most discussions of this methodology focus on maintaining, or consequent variables, antecedent conditions also were arranged to evoke behavior thus maintained. The Demand condition is particularly relevant to the assessment of establishing operations for escape-maintained behavior problems. In that condition, training trials represent the events that may establish their own termination as negative reinforcement. Because escape is contingent on SIB in the Demand condition, a high level of SIB in this condition supports a negative-reinforcement account of SIB and indicates that academic tasks are establishing events. Thus, by arranging a contingency between behavior and a potential maintaining consequence, changes in behavior as a function of the presence or absence of antecedent events may reveal establishing operations. In the current example, the relevant consequences (SIB produces the absence of task demands and other social

interaction) are available in both the Demand and the Alone conditions; however, only the Demand condition contains the suspected establishing condition for escape behavior. Thus, responding in these conditions may be contrasted to infer an establishing function of task demands (the Play condition also serves a control function, however, this condition includes the presentation of adult attention on a fixed-time basis, similar to the presentation of demands in the Demand condition. Thus, if adult attention generally establishes its own termination as a reinforcing event [i.e., if all attention is aversive], a potential confound is introduced.)

It may be proposed that the analysis of conditions (both antecedent and consequent) associated with behavior disorders should contain four elements: (a) conditions that may establish the consequence suspected of maintaining the behavior as reinforcement, (b) conditions that are correlated with the availability of that consequence contingent upon the target behavior, (c) a contingency between the target behavior and reinforcement, and (d) control of (a), (b) and (c) by the experimenter. The ability of antecedent conditions, both establishing and discriminative, to evoke behavior is inextricably linked with reinforcement contingent upon that behavior. Each of these conditions (establishing, discriminative, and consequent) is necessary and none is sufficient for operant behavior to occur and maintain (although it may be argued that discrimination is irrelevant if no condition exists under which reinforcing consequences are not delivered contingent upon responding). Thus, analysis of the importance of antecedent variables requires specification of behavioral consequences, and vice versa. Further, scientific skepticism dictates that experimenters demonstrate functional relations through "controlling the controlling variables," as in (d) above. That is, our certainty about functional relations is increased when we are able to manipulate relevant variables and observe orderly changes in behavior. Naturalistic assessments of setting conditions fail to meet criterion (d), and experimental analyses that manipulate only antecedents fail to meet criterion (c) immediately, and criterion (b) eventually.

Establishing Operations and Treatment for Escape-Maintained Behavior Disorders

The potential importance of identifying establishing conditions when treating maladaptive behavior maintained by negative reinforcement is apparent in a number of studies that manipulate antecedent events to reduce escape behavior.

As previously noted, negatively reinforced behavior presents a unique opportunity for a high level of control over antecedent events; the researcher typically presents the stimulation that occasions escape responding. Thus, several methods have been developed for the manipulation of antecedents to reduce problem behavior maintained by escape. Perhaps the most obvious and direct method of reducing escape behavior involves elimination of aversive events from the environment. An effective, if somewhat impractical strategy. This strategy is analogous to the use of noncontingent reinforcement (NCR) to reduce behavior maintained by social positive reinforcement, in which a manipulation of establishing operations results in the abolition of reinforcer effectiveness and a reduction of attention-maintained responding (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). NCR with escape responding can be expected to have even more dramatic effects on behavior because the event that establishes escape as a reinforcing event can be entirely eliminated. Thus, no escape responding should occur when aversive stimulation is not present. Although no studies have investigated this effect per se, it can be seen in several studies in which no-demand conditions were contrasted with conditions containing demands during assessment (e.g. Carr et al., 1976; Iwata et al., 1982).

A related approach for reducing behavior maintained by social-negative reinforcement is the elimination, and then systematic reintroduction of establishing events into the environment. Pace, Iwata, Cowdery, Andree, & McIntyre (1993) showed that low rates of escape behavior (in this case, SIB) could be maintained when escape extinction (i.e., not permitting escape contingent upon SIB) was combined with a gradual fading in of

the frequency of task trials. This procedure is analogous to that used by Vollmer et al. (1993) to reduce positively reinforced SIB, in both cases the operation establishing the effectiveness of the reinforcer maintaining SIB was gradually introduced into the environment while maintaining an extinction contingency for the response. A subsequent study by Zarcone, Iwata, Vollmer, Jagtiani, Smith, & Mazaleski (1993) showed that instructional fading could enhance the effects of extinction by reducing bursts of responding associated with extinction in the absence of fading. Results of a component analysis of the fading treatment in which instructional fading was implemented without extinction (Zarcone, Iwata, Smith, Mazaleski, & Lerman, in press) showed that, following an initial suppression of SIB, extinction was required to complete the fading procedure for each of 3 subjects. These results suggest a shift in the functional aspects of treatment, from an initial abolition of escape as a reinforcing consequence to extinction of the escape response following "reestablishment" of the reinforcing effectiveness of escape. However, a recent case study reported that demand fading alone was effective in reducing escape-maintained obscene verbalizations in a psychiatric patient (Pace, Ivancic, & Jefferson, in press). Thus, under certain conditions, fading may have durable effects in abolishing the reinforcing effectiveness of task termination.

It may be possible to use fading to alter the establishing effects of other dimensions of task demands. For example, Weeks and Gaylord-Ross (1981) used errorless learning procedures (Touchette & Howard, 1984) to fade along the dimension of task difficulty. Task requirements that initially evoked incorrect responses and maladaptive behavior came to evoke correct responses and no inappropriate behavior. Because the authors did not explicitly state the contingency for maladaptive behavior, it is likely that no change in procedures occurred contingent upon target behaviors (i.e., extinction was in effect for these responses). Thus, the relative importance of extinction versus establishing effects is not known.

Similar results were reported by Cameron, Luiselli, McGrath, and Carlton (1992), showing that noncompliant behavior, which occurred when their subject received a request to exit a van in front of his school, could be reduced by reinforcing approximations of the target response (walking from the van into the school without noncompliance) using a "backward-chaining" procedure. After establishing the presentation of a ball as a conditioned reinforcer by pairing it with preferred activities (gym activities and music), the subject was required to walk to the gym from the classroom, then from outside the building, and finally from the van and through the building, using the ball to reinforce initial and terminal responses in the chain (the chain always ended in reinforcement with gym activities). As in the Weeks and Gaylord-Ross (1981) study, the subject ultimately was required to comply (i.e., to enter the building from the van) throughout the study; thus, extinction of escape-maintained noncompliance probably contributed to the effectiveness of treatment (presuming that noncompliance was maintained by escape – this was not clearly shown in this study). However, in an interesting stimulus-control analysis of this procedure, it was shown that when stimuli correlated with reinforcement by gym activities (i.e., participating staff and the ball) were not present, noncompliance increased over treatment levels. That is, decrements in compliance were observed when participating staff met the subject at his van without the ball, and when nonparticipating staff met the subject at his van with or without the ball. This demonstration of stimulus control over correct responding suggests that reinforcement contingent upon correct responses may have altered the reinforcing effectiveness of escape; when stimuli correlated with reinforcement contingent upon compliance were absent, responses presumably maintained by escape increased.

A component analysis of the motivational and extinction effects of errorless learning and backward chaining procedures would be interesting, because it is possible that such procedures produce direct changes in establishing operations. That is, if the effect of the

errorless learning procedure is to establish in the subject's functional repertoire the skills to respond correctly to tasks that previously evoked incorrect responses, then the establishing function of those tasks may be directly altered. Put another way, easy tasks may not be aversive, and if a difficult task can be transformed into an easy task using errorless training, then it may be possible to avoid evoking escape behavior altogether. Similarly, pairing compliance with requests with reinforcement by requiring only the performance of terminal components of a task (as in backward chaining) may alter the establishing function of the task. These basic alterations of establishing effects are contrasted with fading effects, in which initial reductions in establishing effects may not maintain when aversive events are again presented at baseline frequencies without otherwise altering an aspect of the stimulus or of the subject's repertoire.

Cameron, Ansleigh, and Bird (1992) modified an aspect of a task that had been shown to evoke aggression and noncompliance in their subject. This behavior reliably occurred when the subject was handed a bar of soap and prompted to wash himself. In probe sessions, the trainer presented the subject with a liquid, rather than a solid form of soap, and maladaptive responding was immediately eliminated. The authors termed this a "stimulus control analysis" of the subject's aggression and noncompliance. However, their explanation of the effects of bar soap was that "...the requirement of holding onto a wet bar of soap increased the level of difficulty of the bathing routine and set the occasion for behaviors that would allow (the subject) to successfully escape from the demand." (p. 337). This account indicates that their procedure was an assessment of establishing, rather than discriminative effects. Despite this interpretive inconsistency, their study shows a simple method of reducing escape-maintained maladaptive behavior through modification of establishing conditions. By making a minor modification in the nature of the task demand, the investigators were able to continue training procedures without evoking maladaptive behavior. Further, by utilizing a probe design to assess the effects of their procedure, they were able to limit the possibility that escape extinction (compliance with the

bathing routine was required throughout the study) was responsible for differences in maladaptive responding. That is, liquid soap probes were interspersed among sessions in which bar soap was presented - bar soap sessions continued to evoke maladaptive behavior whereas liquid soap sessions did not. This procedure demonstrated a pragmatic approach in which the goals of training could be achieved and maladaptive behavior could be eliminated merely by modifying a formal property of the task.

Dunlap, Kern Dunlap, Clarke, and Robbins (1991) implemented a molar antecedent intervention that they termed "curricular revision" to reduce the motivation for disruptive behavior and inappropriate vocalizations in an adolescent girl with developmental disabilities. This intervention package included (a) a decrease in the duration of fine-motor activities, (b) interspersing fine- with gross-motor activities, (c) arranging activity content that is "interesting... and leads to a concrete and preferred outcome," (p. 392), and (d) permitting the subject to choose activities from a menu of options when possible. Significant reductions in maladaptive behaviors and increases in appropriate responding were shown. However, this study contained a limitation common to other investigations of setting variables: neither the elements of the intervention package responsible for the treatment effect nor the mechanisms of change can be identified, because none was sufficiently controlled. Further, although the consequences for maladaptive behaviors during baseline were task termination and seclusion time-out (i.e., escape), the contingencies for maladaptive behavior during treatment were not described. Unless the escape contingencies remained in place during treatment, the possible role of extinction in treatment effects must be considered.

Other methods of reducing the motivation to engage in escape behavior also have been investigated, including embedding demands in pleasant stories (Carr et al., 1976) or in the context of easy tasks (Horner et al., 1991). Carr et al. interpreted the effectiveness of these procedures in terms of discriminative operations, suggesting that demands exerted

stimulus control over their subject's SIB_1 and that pleasant stories were discriminative for behavior incompatible with SIB (arguments against such a conceptualization of aversive stimuli in the negative reinforcement paradigm were presented earlier). The effectiveness of embedded requests also may be better explained as a manipulation that reduced the establishing function of demands. Because there could have been no alteration of a stimulus control function due to the presentation of pleasant stories - the correlation between SIB and task termination remained constant throughout the study - an establishing operation interpretation is supported. Unfortunately, no contingencies were programmed for SIB during this study. A definitive determination of establishing operations versus discriminative control would require examining the effects of embedded demands in the absence of extinction for escape behavior.

Mace and Belfiore (1990) used "high probability demand sequences" to establish compliance in a novel treatment for escape-maintained stereotypy. After presenting a sequence of requests that were correlated with high levels of compliance and low levels of stereotypy, they presented demands that were previously observed to occasion high levels of stereotypy and low levels of compliance. The results of this study showed increases in compliance accompanied by decreases in stereotypy for the second set of demands. The authors interpreted these findings in terms of behavioral momentum (Nevin, Mandell, & Atak, 1983), in which persistence of behavior is a function of the product of response and reinforcement rates. By increasing both response and reinforcement rates through the presentation of high-probability sequences, compliance with "low probability" demands was predicted due to the persistence of the response class of compliance. Several possible mechanisms were suggested to explain reductions in stereotypy, including topographical or functional incompatibility between compliance and stereotypy and an inverse relation between concurrent operants. Each of these accounts suggests a change in the relative reinforcing efficacy of escape: either stereotypy was reduced because of the presence of

alternative reinforcers because performance of other responses altered the extent to which aversive stimulation evokes escape responses, or due to a combination of the two. However, as in several previous examples, escape was not available following occurrences of the target response during treatment, and thus it is possible that extinction was responsible for treatment effects.

In a subsequent component analysis of the effects of high probability demand sequences on SIB maintained by escape (Zarcone, Iwata, Hughes, & Vollmer, 1993), the effectiveness of this procedure was replicated when escape was not contingent upon SIB (i.e., when extinction was in effect), but the high probability sequence was ineffective in reducing SIB that produced escape. These results suggest that escape extinction may be necessary for the success of the high-probability sequence, at least when it is applied as treatment for escape behavior. In fact, these investigators reported that demands initially associated with high probabilities of compliance and low probabilities of SIB came to evoke SIB and lower rates of compliance when the high probability sequence was presented alone. This result resembles the reflexive conditioned establishing operation described by Michael. The high probability sequence reliably preceded the presentation of a low-probability demand, and was thus correlated with "worsening." Eventually, the high probability sequence began to evoke escape responding, as would be predicted by the model of the reflexive conditioned establishing operation. This was the opposite effect intended, the expected outcome of the relationship between high-probability sequences and low probability demands was to reduce or eliminate the establishing function of low-probability demands.

These examples show an emerging trend toward the manipulation of antecedent conditions in general and putative establishing operations in particular, as treatment for maladaptive behavior maintained by escape. Movement toward the use of antecedent interventions currently receives a great deal of support from researchers who emphasize the

proactive and "nonaversive' nature of such an approach (Dunlap et al , 1994, Evans & Meyer 1985) However, a review of empirical support for such an approach shows that studies based on exclusively on antecedent control over problem behaviors are extremely rare; most studies involving manipulations of antecedent conditions also include extinction contingencies for maladaptive behavior or other treatment components that obscure the effects of antecedent based treatment Thus, although preliminary results of antecedent approaches are encouraging, refinement of the methods used to evaluate the effectiveness of such procedures is necessary

The current series of studies was developed to demonstrate a simple yet relatively generic methodology for assessing establishing effects for negatively reinforced behavior. After first identifying the variables maintaining SIB through functional analysis (Study 1), some establishing properties of task demands were investigated. By maintaining a reinforcement contingency between target responses (SIB) and escape from trials, one may investigate establishing effects either by holding conditions constant and observing changes in response patterns (e.g., Studies 2 and 3), or by altering a dimension of the establishing event and observing changes in responding (Study 4) Thus isolating the effects of antecedent conditions permits attribution of observed changes in behavior to alterations in the reinforcing effectiveness of escape as a consequence. because that consequence is always presented following SIB If there are no conditions under which target responses are not reinforced, then an account of changes in those responses necessarily involves alterations in the functional properties of the reinforcer to maintain responding. The next section contains a description of general methods employed throughout the current series of studies

GENERAL METHOD

Subjects and Setting

Ten individuals with developmental disabilities participated one or more of four studies. All lived in a public residential facility, and all had previously received a diagnosis of profound mental retardation. The subjects were referred to a specialized program for the assessment and treatment of SIB based upon histories of chronic SIB.

Walter was 31 years old when he participated in the current experiment. He was referred for treatment of hand biting. Walter displayed no expressive language skills but he was able to respond to a few simple requests. Walter participated in Studies 1 and 2 of the current experiment.

Landon was a 44-year-old man whose SIB consisted of head and body hitting, head banging, and hand biting. He did not show expressive verbal skills, but he was able to respond to some simple directions. Landon participated in Studies 1, 2, and 4 of the current experiment.

Daphne was 33 years old at the time of her participation in the study. She was referred for treatment of head hitting and banging. Daphne displayed some imitative vocalizations and she was able to mand with a repertoire of 4-5 manual signs. Daphne was able to understand a few simple directions. Daphne participated in Study 2 of the current experiment.

Olivia was 27 years old when she participated in this experiment. Her SIB consisted of head hitting. She was deaf and blind, she did not show expressive language skills, and

she did not appear responsive to directions from caregivers. Olivia participated in Studies 1 and 4 of the current experiment.

Larry was 46 years old at the time of the experiment. His referral for treatment was based upon a history of very severe and chronic head hitting and hand biting. Larry wore a protective helmet when he was not participating in assessment or treatment sessions. The helmet was prescribed by Larry's physician partly due to his SIB, and partly because Larry occasionally fell due to an unsteady gait and infrequent seizures. Larry had no expressive language skills and he responded to a few simple requests. Larry participated in Studies 1, 3, and 4 of the current experiment.

Carl was 38 years old during his participation in this experiment. He was referred for treatment of head hitting and banging and arm and wrist biting. Carl did not exhibit expressive verbal skills at the time of this experiment, and he appeared responsive to a limited number of requests from caregivers. Carl participated in Studies 1, 3, and 4 of the current experiment.

Stan was 47 years old at the time of his participation in this experiment. His SIB consisted of head and body hitting and head banging. Stan displayed some echolalic vocalizations and he responded to simple directions. Stan participated in Studies 1, 3, and 4 of the current experiment.

Helen was 28 years old at the time of this experiment. She was referred for treatment of head and body hitting, including knee-to-head contact. She did not exhibit expressive language skills but she was responsive to several requests from caregivers. Helen participated in Studies 1, 3, and 4 of this experiment.

Evelyn was 33 years old when she participated in the current experiment. She was referred for treatment of head and body hitting, head banging, and hand biting. Evelyn had a limited verbal repertoire, consisting exclusively of vocal mands for reinforcers such as

"candy" and "cookies." She appeared to understand a few simple directions. Evelyn participated in Studies 1 and 3 of the current experiment.

Milt was 43 years old at the time of his participation in this experiment. He was referred for treatment of head banging and body hitting. Milt did not display expressive language skills and he responded to only a few simple requests from caregivers. Milt participated in Studies 1 and 3 of the current experiment.

All sessions were conducted at a day program for the assessment and treatment of SIB located on the grounds of the subjects' residence. Therapy rooms contained chairs, tables, and other furnishings, as well as materials that varied as appropriate for conducting conditions of the assessment (see Procedures section of Study 1). Sessions lasted for 15 minutes unless otherwise noted. Between one and four sessions were conducted each day, and sessions typically were conducted five days per week.

Human Subjects Protection

An experimental analysis of the functional properties of SIB requires that subjects be permitted to engage in SIB during assessment sessions. Thus, assessment and treatment protocols were reviewed and approved by a university institutional review board. Several procedures were implemented to reduce the risk of injury to subjects. First, participation in this research was contingent on approval of medical personnel and of each subject's interdisciplinary team. Second, each subject was monitored by nursing staff on a daily basis. Third, standard session termination criteria were established by medical personnel, and, when necessary, individualized procedures were implemented (e.g., the use of protective equipment, individualized session termination criteria, etc.) to reduce risk further. Finally, medical personnel were always present on the grounds of the facility and available (via telephone or beeper) to respond immediately in the event of injury or other special circumstances.

Response Measurement

Topographies of SIB were operationally defined for all subjects as follows: Head hitting (Daphne, Landon, Olivia, Larry, Carl, Stan, Helen, Evelyn): forceful contact against any area of the the face or head by any other portion of the body, including open hands, fists, and knees. Head banging (Daphne, Landon, Carl, Stan, Evelyn, Milt): forceful contact by the head against surfaces including walls, furniture, and floors. Hand or arm biting (Walter, Landon, Larry, Carl, Evelyn): contact of the mouth or teeth against any area of the hand, wrist, or arm. Body hitting (Landon, Stan, Helen, Evelyn, Milt): forceful contact of any portion of the body against any other portion of the body other than the head (e.g., fists against torso, elbow against legs, open hands against arms, etc.).

Data were collected using hand held computers (Assistant Model 101), and (unless otherwise stated in Procedures sections) were calculated as responses per minute of SIB by dividing the number of self injurious responses recorded by the number of minutes of session time.

In order to assess reliability, a second observer simultaneously but independently recorded data during 38.2% of all observations (37.4% of sessions in Study 1, 30.2% of sessions in Study 2, 38.4% of sessions in Study 3, and 47.7% of sessions in Study 4). Interobserver agreement scores were calculated by first dividing session time into consecutive 10-s intervals. The smaller number of responses was divided into the larger number of responses recorded during each interval, and those values were averaged across the session. Mean agreement scores for SIB were 97.8% overall (range, 80.1% - 100%). Mean agreement scores were 98.6% during Study 1 (range, 80.1% - 100%), 96.7% during Study 2 (range, 85.1% - 100%), 97.6% during Study 3 (range, 89.8% - 100%), and 97.3% during Study 4 (range, 89.8% - 100%).

STUDY 1: FUNCTIONAL ANALYSIS OF SIB

Procedures

All subjects except Daphne participated in Study 1, in which an experimental analysis was conducted to identify the functional properties of each subject's SIB. The procedures were based on those described by Iwata et al. (1982). The assessment consisted of four conditions, three of which represented a contingency for SIB analogous to contingencies observed in the natural environment. The fourth condition was presented as a control. These conditions were presented to each subject in a multielement experimental design and are described below.

Alone. The subject was placed in a therapy room alone, with no toys or other materials available. This condition was conducted in order to assess an automatic reinforcement, or self stimulatory function of SIB, which would be indicated by persistence of SIB when no social reinforcement was delivered.

Attention. The subject was placed in a therapy room with play materials available. The experimenter directed the subject toward the materials, then engaged in other activities while remaining in the presence of the subject (e.g., seated in a chair across the room). If the subject engaged in self injury, the experimenter approached the subject and provided brief attention in the form of social disapproval or concern and brief physical contact (e.g., hand on shoulder or response blocking). Responses other than SIB were ignored. This condition was conducted to determine if SIB could be maintained by positive reinforcement in the form of attention from caregivers.

Demand. The subject was placed in a therapy room with task materials present. The experimenter initiated learning trials with the subject approximately every 30 s (a Fixed Time or FT, 30 s schedule) using a graduating prompts procedure (verbal instruction, visual prompt, physical guidance) at 5-s intervals when compliance had not occurred. A variety of tasks, similar to those found in subjects' habilitation plans, was presented each session. Task requirements were withdrawn contingent upon SIB, the experimenter turned away from the subject, and no further tasks were presented until the next scheduled trial. SIB occurring within 5 s of the next scheduled task presentation delayed that presentation for 5 s. This condition was conducted to determine if SIB could be maintained by escape from task requirements. A variation of this condition (Music) was conducted for Milt, who had been observed to engage in SIB in the presence of loud noises and music. Milt was placed in a room in which music was presented continuously and was withdrawn for 20-s contingent upon SIB. This condition assessed whether Milt's SIB was maintained by termination of noise.

Play. In this condition the experimenter provided attention approximately every 30 s (contingent upon a 5 s absence of SIB), and the subject had continuous access to toys and games. The subject received no task demands in this condition, and SIB produced no social consequences. The purpose of this condition was to serve as a control for SIB (very little SIB was expected to occur because of a high level of noncontingent social attention, the absence of task demands, and access to stimulating materials).

Results

Results of the functional analysis of SIB revealed that all subjects except Milt engaged in highest levels of SIB in the Demand assessment condition. Milt's SIB was highest in the Music condition. Individual results are presented in Figures 1, 2, and 3.

The results of Walter, Landon, and Olivia's functional analysis are presented in Figure 1. Walter's data are shown in the top panel of Figure 1. Condition means for Walter's SIB were Demand (6.28 responses per minute [rpm]), Alone (1.30 rpm) Attention (0.58 rpm), and Play (0.10 rpm). Landon's data are shown in the center panel of Figure 1. Condition means for Landon's SIB were Demand (0.92 rpm), Alone (0.50 rpm), Attention (0.23 rpm), and Play (0.18 rpm). Olivia's data are shown in the bottom panel of Figure 1. Condition means for Olivia's SIB were Demand (3.26 rpm), Alone (0.00 rpm), Attention (0.11 rpm), and Play (0.05 rpm).

Larry's data are presented in the top panel of Figure 2. Condition means for Larry's SIB were Demand (2.30 rpm), Alone (0.60 rpm), Attention (0.20 rpm), and Play (1.56 rpm). Carl's data are presented in the center panel of Figure 2. Condition means for Carl's SIB were Demand (2.88 rpm), Alone (0.00 rpm), Attention (0.00 rpm), and Play (0.25 rpm). Stan's data are presented in the bottom panel of Figure 2. Condition means for Stan's SIB were Demand (2.2 rpm), Alone (0.36 rpm), Attention (0.53 rpm), and Play (0.30 rpm).

Helen's data are presented in the top panel of Figure 3. Condition means for Helen's SIB were Demand (5.51 rpm), Alone (0.40 rpm), Attention (1.84 rpm), and Play (0.50 rpm). Evelyn's data are presented in the center panel of Figure 3. Condition means for Evelyn's SIB were Demand (0.26 rpm), Alone (0.01 rpm), Attention (0.00 rpm), and Play (0.00 rpm). Milt's data are presented in the bottom panel of Figure 3. Condition means for Milt's SIB were Music (1.45 rpm), Demand (0.03 rpm), Alone (0.02 rpm), Attention (0.03 rpm), and Play (0.00 rpm).

Figure 1. Functional analysis results for Walter (top panel), Landon (center panel), and Olivia (bottom panel)

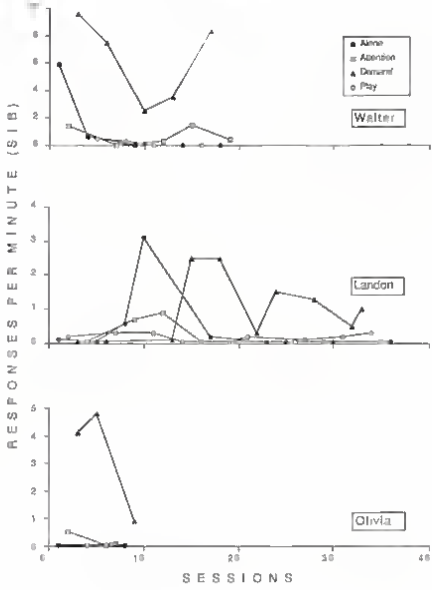

Alone
Attention
Demand
Play
Walter
Landon
Olivia
RESPONSES PER MINUTE (S I B)
SESSIONS

Figure 2 Functional analysis results for Larry (top panel), Carl (center panel), and Stan (bottom panel)

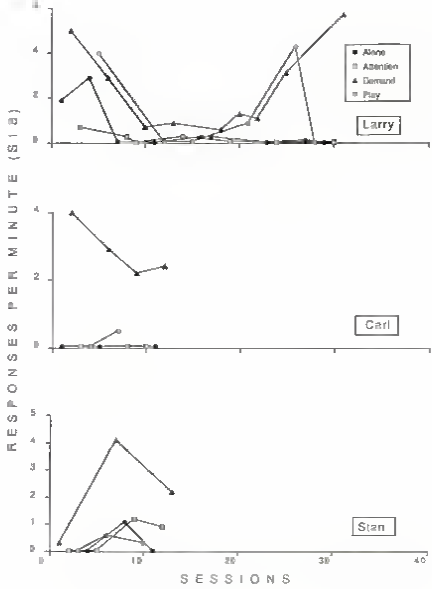
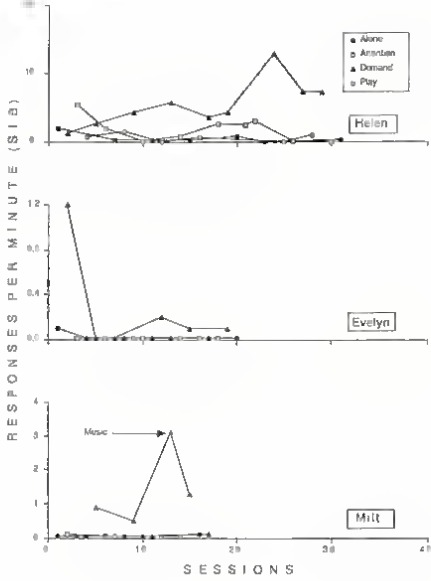

Alone
Attention
Demand
Play
Larry
Carl
Stan
RESPONSES PER MINUTE (S1a)
SESSIONS

Figure 3 **Functional analysis results for Helen (top panel), Evelyn (center panel), and Milt (bottom panel).**


Alone
Attention
Demand
Play
Helen
Evelyn
Milt
Music
RESPONSES PER MINUTE (SIB)
SESSIONS

Discussion

Study 1 replicated an assessment of the functional properties of SIB initially demonstrated by Iwata et al. (1982). This assessment method has been extensively replicated since its development, and its utility and adaptability for revealing the variables maintaining problem behaviors has been well established in the literature (see Iwata, Vollmer, & Zarcone, 1991, and Mace, Lalli, & Pinter Lalli, 1991, for reviews).

The results of the current study indicate that each subject's SIB was maintained by escape. All subjects except Milt showed highest levels of SIB in the Demand condition. Milt's SIB occurred most frequently in the Music condition designed to assess whether escape from noise maintained his SIB. Thus, although establishing stimuli were different for Milt, the SIB of all subjects was maintained by negative reinforcement.

Data showed very clear response patterns within 9 - 20 sessions for most subjects' SIB; however, extended assessments were required to reveal the functions of Landon's, Larry's, and Helen's SIB. Landon's SIB initially occurred at low levels in all conditions, perhaps due to a failure of his behavior to come under discriminative control of the various contingencies. However following the fifteenth session of assessment, Landon's SIB was consistently highest in Demand relative to other conditions of the assessment. Larry's SIB did not differentiate for several sessions, and he continued to display variable rates of SIB in the Play condition throughout his assessment. This may reflect a generalization effect, as discussed previously (see "Functional Analysis of Antecedent Events in Behavior Disorders" section of this manuscript). It is possible that similarities between the Demand and Play conditions (e.g., presence of materials, FT 30-s approach of experimenter) may have interfered with the establishment of discriminative control for Larry's SIB. Results of recent research suggest that the mere presence of a trainer may be a conditioned aversive event for certain subjects, thus, experimenter approach in the Play condition may occasion

SIB maintained by escape from social interaction in general (Taylor & Carr, 1992, Taylor, Ekdahl, Romanczyk, & Miller, 1994), and subsequent withdrawal of experimenter attention may adventitiously reinforce such responding. Therefore, an escape account for Larry's SIB is not inconsistent with the continued occurrence of some SIB in the Play condition. Helen's SIB was undifferentiated during early sessions of her assessment; however, following her second exposure to each condition she displayed consistently highest rates of SIB in the Demand condition, with all other conditions eventually producing zero or near zero rates of SIB.

Daphne did not participate in Study 1. Results of a previous functional analysis had shown her SIB to be maintained by contingent attention from caregivers, and she had received successful treatment based on this outcome. However, reports from attending staff and casual observation indicated that Daphne exhibited SIB in the presence of a single task demand, and she was re-referred for further treatment. The task demand associated with SIB was incorporated into the Demand condition of the functional analysis for Daphne, and persistent SIB in this condition was considered evidence of an escape function for her SIB. The outcomes of this condition are presented in Figure 4.

Study 1 served as a screening procedure to identify subjects whose SIB was maintained by escape from demands. These subjects then participated in one or more subsequent studies in which the establishing properties of specific antecedent events were examined.

STUDY 2--EFFECTS OF NOVEL TASKS ON SIB

In Study 2, the effects of task novelty on SIB maintained by escape from task demands were investigated. An assessment of conditions associated with stereotypy (Mace, Browder, & Lin, 1987) found that higher levels of stereotypy were observed when subjects were presented with novel versus familiar tasks (spreading peanut butter on crackers versus making instant hot chocolate, peeling hard boiled egg, cinnamon toast, and instant pudding). However, because the tasks were dissimilar in several respects it was not possible to control for other establishing operations associated with each task. That is, the novel tasks may have contained features other than novelty that were associated with increases in stereotypy (e.g., duration of session, "effort" etc.). Further, the authors stated that "no planned response was made to stereotypy" (p. 27) during comparison conditions--indicating no escape from task trials was possible. Unless stereotypy resulted in the withdrawal of tasks (i.e., escape from task requirements) it would not be possible to evaluate the establishing effects of novelty, although no other studies have reported results of this manipulation.

The current study investigated the effects of task novelty on escape maintained SIB by conducting Demand sessions that contained repeated presentations of task demands not previously presented in the experimental situation. By presenting each new task repeatedly it was possible to examine the course of responding over sessions as subjects developed a history with each demand (i.e., during the transition of demands from novel to familiar [by definition]).

Method

Walter, Landon, and Daphne participated in Study 2. The experimental procedures previously described for the Demand condition in Study 1 were in effect throughout Study 2, with the exception that sessions consisted of repeated presentations of a single task demand, rather than a variety of demands.

For Walter and Landon, a combination multiple baseline and multielement experimental design was used to assess the effects of task novelty on SIB. Following at least three consecutive sessions in which rates of SIB stabilized or showed a decreasing trend and occurred at rates below 0.5 rpm, a new demand was presented in separate sessions. Occasional sessions with the immediately previous task demand continued in order to assess potential covariation in SIB across tasks. For Walter, two sessions were conducted with tasks that initially occasioned less than 0.5 rpm of SIB, and for Landon three sessions were conducted with tasks that initially occasioned less than 1 rpm of SIB. Because these tasks were associated with low levels of escape responding, no further sessions with them were conducted and data from those sessions are not included in data presentation.

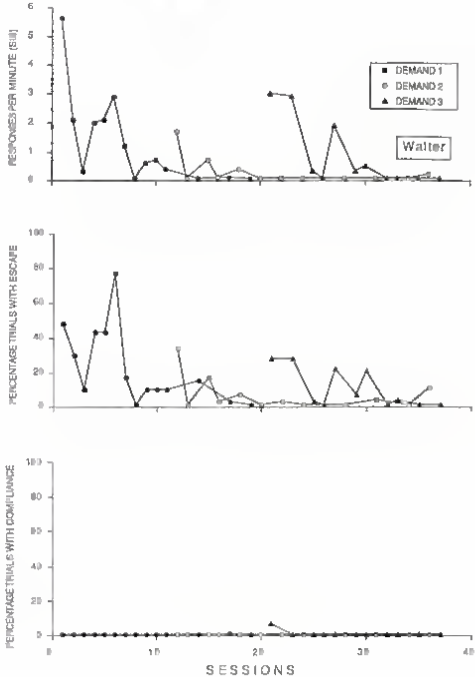
Only a single task demand was presented to Daphne because results of previous assessment, combined with casual observation and staff report, indicated that Daphne exhibited escape SIB that was idiosyncratic to a particular request. Daphne's escape SIB occurred only when she was asked to stand up and walk. Thus, it was not possible to assess the novelty of the task per se, but only to present the task in the context of a novel setting and experimenter. Also, because the form of SIB predominantly exhibited by Daphne in this situation was extremely severe (Daphne would fall to the floor and attempt to bang her head) the sessions in this study served as a baseline for immediate treatment.

In order to determine if observed changes in SIB were due to variables other than establishing operations, data were collected on two additional variables -- percentage of trials with compliance and percentage of trials with escape. If increases in compliance were observed across sessions, then decreases in SIB may be due to the indirect effects of increased reinforcement for compliance rather than establishing operation effects of repeated presentation of tasks. Percentage of trials with compliance was calculated for each session by dividing the number of trials with compliance into the total number of trials. If the percentage of trials escaped did not decrease (or increased) across trials, then decreases in SIB may be due to a gradual improvement of schedule control over SIB, rather than establishing operation effects of repeated presentation of tasks. That is, experience with a Continuous Reinforcement schedule (CRF) for SIB may have produced more efficient responding, allowing the rate of SIB to decrease, although percentage of trials escaped remained stable or increased. Percentage of trials with escape (i.e., the percentage of trials during which SIB was scored) was calculated for each session by dividing the number of trials with escape into the total number of trials.

Results

The results of Study 2 are presented in Figures 4, 5, and 6. Walter's data are displayed in Figure 4. The top panel of Figure 4 shows the frequency of Walter's SIB. Demand 1 initially occasioned high rates of responding (5.6 rpm in the first session), which decreased to near zero levels over 14 sessions. Sessions with Demand 2 were introduced following the eleventh session with Demand 1. Although initial levels of SIB were relatively low with Demand 2 (1.7 rpm in the first session), the decreasing response pattern seen in Demand 1 was replicated with Demand 2. After the sixth session with Demand 2, sessions with Demand 3 were introduced. The rate of SIB in the first session

Figure 4. Results of Study 2 for Walter. Rates of SIB are shown in the top panel. Percentages of trials with SIB are shown in the middle panel. Percentages of trials with compliance are shown in the bottom panel.


RESPONSES PER MINUTE (S/M)
DEMAND 1
DEMAND 2
DEMAND 3
Walter
PERCENTAGE TRIALS WITH ESCAPE
PERCENTAGE TRIALS WITH COMPLIANCE
SESSIONS

with Demand 3 was 3 0 rpm, and the trend with Demand 3 replicated that seen with Demands 1 and 2, SIB decreased to zero rates over 11 sessions

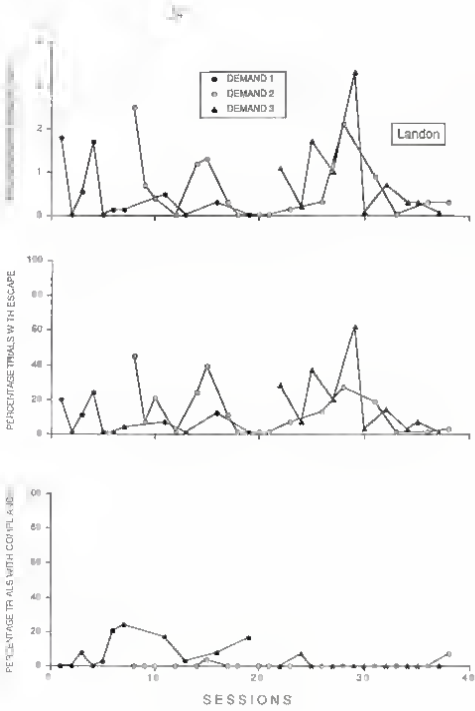
Data showing Walter's percentage of trials with escape are shown in the middle panel of Figure 4 These data show similar patterns to those seen with rate of SIB During Walter's first session with each new demand he escaped 48%, 17%, and 28% of trials, respectively for Demands 1, 2, and 3 Mean percentages of escape for the final three sessions with each demand were 6% for Demand 1, 5% for Demand 2, and 0% for Demand 3

Data showing Walter s compliance with trials are presented in the bottom panel of Figure 4 Compliance occurred during only two sessions for Walter; once with Demand 1, and twice with Demand 3

Landon's data are shown in Figure 5 The top panel shows the frequency of Landon's SIB Landon exhibited 1 8 rpm of SIB during the first session with Demand 1. Some variability was observed over the next 3 sessions, after which Landon's SIB stabilized below 0.5 rpm and eventually decreased to zero by the eleventh session. Following the seventh session with Demand 1, sessions with Demand 2 were introduced. Landon's SIB occurred at a rate of 2.5 rpm during the first session with Demand 2. After a decrease in responding to zero rpm for three consecutive sessions, SIB recovered coincident with the introduction of Demand 3 Following this recovery, SIB again decreased to below 0 5 rpm. Sessions with Demand 3 were introduced following the tenth session with Demand 2. SIB showed an increasing trend over the first 5 sessions, then decreased to below 0.5 rpm within 10 sessions

Data showing Landon's percentage of trials with escape are shown in the center panel of Figure 5 As in Walter's case, percentages of escape corresponded closely with SIB. During Landon's first session with each new demand he escaped 20%, 46%, and 28% of trials, respectively for Demands 1, 2, and 3 Mean percentages of escape for the

Figure 5 Results of Study 2 for Landon Rates of SIB are shown in the top panel. Percentages of trials with SIB are shown in the middle panel. Percentages of trials with compliance are shown in the bottom panel.


DEMAND 1
DEMAND 2
DEMAND 3
Landon
PERCENTAGE TRIALS WITH ESCAPE
SESSIONS

final 3 sessions with each demand were 4% for Demand 1, 1% for Demand 2, and 3% for Demand 3

Data showing Landon's compliance with task demands are presented in the bottom panel of Figure 5. Landon's compliance occurred at low levels across task demands, with a slight increasing trend apparent for Demand 1. Landon seldom complied with Demands 2 and 3 and did not exhibit compliance in the first session with any demand. Mean percentages of compliance in the final 3 sessions with each demand were 8% for Demand 1, 2% for Demand 2, and zero percent for Demand 3

Daphne's data are presented in Figure 6. The top panel shows the frequency of Daphne's SIB, which occurred at high and variable levels during the first 4 sessions (mean rpm sessions 1-4: 8.5 rpm), then decreased to lower and stable rates over a total of 15 sessions (mean rpm sessions 5-15: 2.3 rpm)

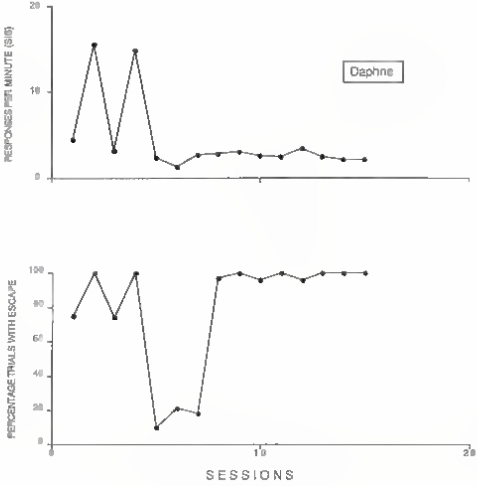
The lower panel of Figure 6 shows percentages of demands escaped by Daphne. During the first seven sessions of Daphne's assessment, escape appeared to covary with SIB. However, while rates of SIB remained low and stable throughout the remainder of sessions, percentages of escape increased sharply, averaging 98.6% of tasks escaped during the final 8 sessions

Daphne did not comply with any task requirements during her participation in this study

Discussion

The results of Study 2 suggest that task novelty can alter the reinforcing effectiveness of trial termination for some subjects. Walter's and Landon's decreases in self-injurious escape responding across sessions (i.e., as task requirements became "more familiar") were replicated for three separate tasks, suggesting a reliable effect. Thus, given

Figure 6. Results of Study 2 for Daphne. Rates of SIB are shown in the top panel. Percentages of trials with SIB are shown in the middle panel.


RESPONSES PER MINUTE (S/M)
20
10
0
Daphne
PERCENTAGE TRIALS WITH ESCAPE
100
80
60
40
20
0
10
20
SESSIONS

the availability of trial termination contingent upon SIB the effect of repeated task presentation was reliable decreases in SIB for these subjects. There are three possible accounts for decreases in SIB as tasks become more familiar. First, SIB may be reduced due to changes in the establishing properties of demands that are repeatedly presented. Second, SIB may be reduced as a side-effect of reinforcement for compliance. Third, SIB may be reduced as it comes under schedule control of the response requirement for trial termination (i.e. responding becomes more efficient)

Walter' and Landon's data appear consistent with an establishing operations account of reductions in their SIB. That is although escape from task demands remained a consequence for SIB the reinforcing effectiveness of trial termination appeared to diminish after repeated presentations of a specific task demand, and thus SIB in the presence of that demand decreased. This alteration of establishing effects may best be attributed to habituation to specific demands. Habituation is defined as "a decrease in the strength of a response after repeated presentation of a stimulus that elicits the response." (Mazur, 1986, p. 48) The course of habituation may include initially large decrements in responding followed by smaller decrements as habituation proceeds--an effect apparent in Walter's data, and to a lesser extent in Landon's data. Another effect of habituation is a recovery of initial effects as a function of increasing periods of time without stimulus presentation. Although this effect was not assessed in the current study it is possible to further investigate this account by re-presenting task demands that have occasioned decreases in responding due to repeated presentations following a period during which those demands have not been presented.

An alternative account for these data is that SIB may have decreased as a function of an increase in reinforcement for an alternative response (i.e., compliance). However, this account requires trends in compliance in the opposite direction of those for SIB (i.e. increases in compliance concurrent with decreases in SIB), and only in Landon's

compliance data with Demand 1 was a very slight increasing trend observed. No compliance score exceeded 25%, and the slight increase in Landon s compliance with Demand 1 was not replicated with Demands 2 or 3. Thus, it is unlikely that decreases in responding for Walter and Landon occurred as a function of increases in reinforcement for compliance.

Decreases in escape maintained SIB when demands are presented at a constant rate (as in the current experiment) also may be attributable to a learning effect, in which subjects simply become more efficient "escapers." That is, subjects may learn to emit only the amount of responding required for trial termination (2 rpm in the current experiment). This account attributes decreases in SIB to the development of schedule control over response rates rather than to an establishing operation Given this account, percentages of trials escaped should remain relatively constant or increase during the course of assessment; although response rates may decrease they will remain at sufficient levels to produce reinforcement. Both Walter's and Landon s data showed that, for each task, the percentage of task trials escaped decreased over time Thus a response-efficiency account does not adequately describe the data for Walter or Landon.

Daphne's data are more equivocal Although a decreasing trend followed by low, stable patterns of responding with Demand 1 is apparent, it was not possible to replicate these effects with other task demands. Therefore, the reliability of this response pattern is questionable for Daphne Interpretation of Daphne's data also is less straightforward. Daphne s results show a general decrease in SIB, as did Walter's and Landon's. However, her data also reveal that percentages of escape actually increased over the course of the study (following a slight decrease during sessions 5-7) Thus, her data do not appear to be consistent with a habituation account due to very high percentages of escape, suggesting that trial termination maintained its effectiveness as a reinforcing consequence Daphne did not exhibit compliance to any demands, indicating that decreases in SIB were

not due to reinforcement for compliance. Thus, the most viable explanation for Daphne's results is that her SIB came under schedule control of the continuous reinforcement contingency with a fixed number of trials, permitting the most efficient pattern of escape responding to emerge.

The results of Study 2 indicate that the current procedure is an effective method for examining functional relationships between novel tasks and escape behavior. The results for two subjects were consistent with the reduction of an establishing effect for trial termination through habituation, the results of a third subject appeared most consistent with a schedule control account of changes in response rates.

These outcomes indicate that it is important to collect and review data on compliance and percentage of tasks escaped, as well as SIB, in order to discriminate among three possible accounts of the patterns of SIB observed in this study. This discrimination may be important for developing treatment plans for subjects with maladaptive behavior maintained by escape. First, for individuals whose escape behavior is sensitive to novelty as an establishing operation it may be helpful to introduce new tasks slowly, and to minimize the effects of novelty by arranging for new tasks to be as similar as possible to previously learned tasks. In addition, knowledge that task familiarity reduces the occurrence of escape behavior may permit trainers to avoid using escape extinction, and thus avoid the negative side-effects associated with that procedure (e.g., extinction bursts, aggression against trainers, etc.) That is, if trainers persist in presenting new tasks escape behavior will eventually decrease *without* implementing extinction (i.e., even when escape is contingent on maladaptive behavior). Alternatively, if escape extinction is necessary, it may be helpful to allow escape behavior to stabilize at lower levels prior to implementing extinction during sessions that occasion high levels of escape behavior.

If a subject shows a tendency toward increased compliance and decreased maladaptive escape behavior as tasks become more familiar it again may be possible to

avoid implementing extinction for escape responses. Instead, strategies for facilitating acquisition of compliance (e.g., errorless learning procedures) may increase compliance and suppress escape behavior. If escape extinction is then deemed necessary (i.e., if escape behavior is not eliminated due to increases in compliance), then extinction may be used as a compliment to the effects of reinforcement. Similarly, if a subject's behavior appears to come under schedule control following initially high rates of escape behavior it may be helpful to allow schedule control to occur before implementing extinction. This may facilitate the transition from a continuous reinforcement schedule to an extinction contingency. Finally, if an individual's maladaptive escape behavior does not appear sensitive to task novelty as an establishing operation, and if neither percentages of escape or compliance change over time, then escape extinction or treatment approaches based upon other variables may be considered.

STUDY 3: EFFECTS OF SESSION DURATION ON SIB

The duration of training sessions may alter the reinforcing effectiveness of trial termination for persons with maladaptive behavior maintained by negative reinforcement. There are three possible effects of session duration. First, session duration may have no effect on behavior. That is, levels of maladaptive behavior may be relatively constant regardless of session duration. Second, escape behavior may decrease during a session suggesting that trial termination is a more effective reinforcer during early versus later moments of sessions. Third, escape behavior may accelerate during sessions, indicating that the reinforcing effectiveness of trial termination increases during sessions.

Very little research has investigated the effects of the temporal extension of sessions on escape behavior. Dunlap et al. (1991) compared the effects of short versus long tasks on the disruptive behavior of a female adolescent with multiple disabilities. In the long-task condition, the subject was presented with workbook exercises and instructed to work for 15 min. In the short-task condition, the instructor presented the subject with a portion of exercises expected to take approximately 5 min to complete. Results showed that disruptive behavior occurred frequently during long tasks, but rarely during short tasks. The authors noted that atypically high levels of disruption were seen in one short-task session in which the cue that the session was going to be short was ambiguous (i.e., when the subject received only presession verbal instructions about session length, rather than a finite set of problems to work), suggesting that cues relative to session requirements may interact with, and alter the function of, task demands. Thus, it is difficult to separate the effects of session duration from those of two types of presession instructions (i.e., "finish

these problems" versus "work for 15 minutes"). No other research has focused on the effects of task duration on behavior problems maintained by escape.

The present study investigated the effects of session duration on escape-maintained SIB by examining trends in responding during sessions of equal length. That is, within-session responding during 15 min sessions was examined to reveal trends that occurred as a function of time-in-session

Method

Evelyn Landon Helen Carl, Larry, Milt and Stan participated in Study 3. The experimental procedures previously described for the Demand assessment condition were in effect throughout Study 3. Each subject received several task demands during each 15-min session, taken from a pool of demands previously found to occasion SIB with that subject. These task demands were presented in random order on a Fixed Time 30s schedule Contingent upon compliance, subjects received verbal praise and no further demands until the next scheduled trial SIB always resulted in termination of (i.e., escape from) the current trial.

Data were summarized in consecutive 30-s intervals in order to inspect trends over the duration of the sessions. Data were then summed across sessions, and presented in two formats. A frequency distribution was prepared for each subject, using a histogram to show the number of responses occurring in each consecutive 30-s interval, summed over sessions (Note 29, rather than 30 intervals are represented on all graphs Due to a program error in the data collection computers, the first 28 intervals represent 31.4 s duration, and the 29th interval represents 20 8 s). Data thus summarized reveal the temporal patterning of responses over consecutive intervals A cumulative record also was prepared for each subject. Data points on these graphs represent the sum of self injurious

responses for the current plus all preceding 30-s intervals. These data also were summed across sessions. Data presented in a cumulative record reveal accelerating or decelerating trends in behavior during sessions. Trends are indicated by the slope of the data path, with a horizontal line indicating that no responding occurred during that time, and lines with steep slopes indicating rapid responding. Thus, a straight line shows steady-state responding, a curve of increasing slope indicates acceleration of responding over time, and a decreasing slope indicates deceleration of responding over time. These two formats for data display permit an inspection of within-session responding that reveals relationships between time-in session and trends in SIB.

Results

Evelyn's results are presented in Figure 7. The upper panel shows the number of responses recorded during successive 30-s intervals, summed across 11 sessions. Evelyn responded only once each in the 5th, 9th, and 19th intervals; however, two or more responses occurred in each remaining interval, increasing to a high of 36 responses in the 26th interval before showing a decrease at the end of sessions. Evelyn's cumulative record is presented in the lower panel of Figure 7, and shows a virtually flat line during the first 10 min of sessions, when a rapid increase in SIB occurred, showing an accelerating trend until the final minute of sessions.

Landon's results are presented in Figure 8. The upper panel shows the number of responses recorded during successive 30-s intervals, summed across 14 sessions. Landon responded infrequently during early intervals of his sessions, with intervals of increasing SIB seen as session length increased beyond 4 min. Landon's SIB reached its highest level during the final third of the session. Landon's cumulative record is shown in the lower panel of Figure 8. This graph shows a nearly flat line during the first 5 min of

Figure 7 Results of Study 3 for Evelyn. A frequency distribution of Evelyn's SIB is shown in the top panel. A cumulative record of Evelyn's SIB is shown in the bottom panel.

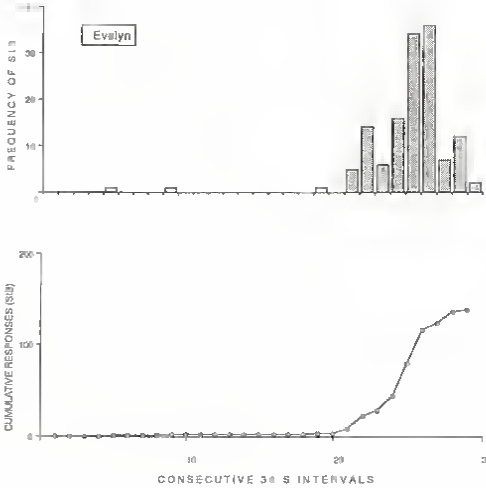
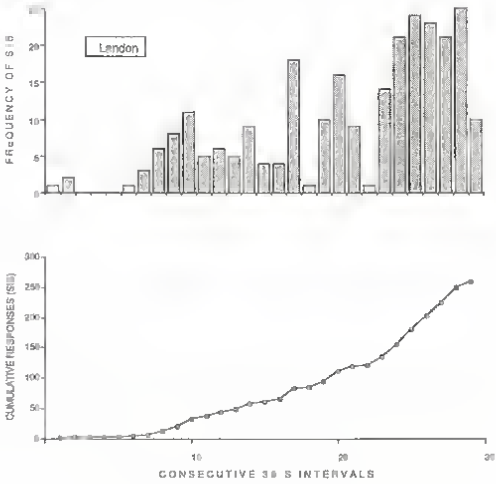

Evelyn
FREQUENCY OF SUB
30
20
10
0
CUMULATIVE RESPONSES (SUB)
200
100
0
10
20
CONSECUTIVE 30 S INTERVALS

Figure 8 Results of Study 3 for Landon A frequency distribution of Landon's SIB is shown in the top panel. A cumulative record of Landon's SIB is shown in the bottom panel


Landon
FREQUENCY OF S/S
CUMULATIVE RESPONSES (S/S)
CONSECUTIVE 30 S INTERVALS

sessions, followed by a gradual increase in responding that maintained throughout the remaining 10 min

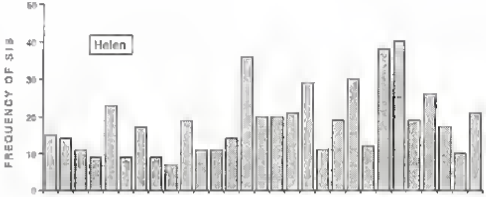
Helen's results are presented in Figure 9 The upper panel shows the number of responses recorded during successive 30-s intervals, summed over 15 sessions These data show that lower frequencies tended to occur earlier in sessions and higher frequencies tended to occur later in sessions, although this trend occurred to a lesser extent than was seen either in Evelyn's or Landoe's data. Helen's cumulative record is shown in the lower panel of Figure 9, and a slight acceleration of responding during sessions may be seen.

Carl's results are presented in Figure 10 The upper panel shows number of responses recorded during successive 30-s intervals, summed over 10 sessions Carl's data show lower frequencies occurring during early intervals and higher frequencies occurring in later intervals Carl's cumulative record is shown in the lower panel of Figure 10 These data show that responding accelerated in the middle of sessions, then decelerated briefly before again showing an acceleration that maintained until the final minute of sessions

Larry's results are presented in Figure 11 The upper panel shows the number of responses recorded during successive 30-s intervals, summed over 15 sessions These data show no clear trends in responding, with periodic "peaks" in intervals during which atypically high rates of SIB occurred (inspection of session-by-session data indicate that these data reflect bursts of responses occurring during one, or a very few, sessions) Larry's cumulative record is shown in the lower panel of Figure 11, and these data show a nearly straight line, suggesting that, in general, Larry's SIB neither accelerated nor decelerated through the duration of sessions

Mike's results are presented in Figure 12. The upper panel shows the number of responses recorded during successive 30-s intervals, summed over 11 sessions These data show that, with some exceptions, higher frequencies tended to occur during earlier intervals and higher frequencies tended to occur later in sessions (e g , the mean frequencies of SIB during the first and last 10 intervals of sessions were 25.5 and 18.5,

Figure 9 Results of Study 3 for Helen. A frequency distribution of Helen's SIB is shown in the top panel. A cumulative record of Helen's SIB is shown in the bottom panel


Helen
FREQUENCY OF SIB
50
40
30
20
10
0

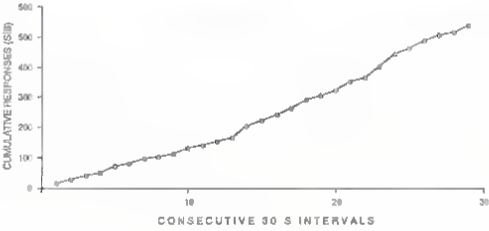

CUMULATIVE RESPONSES (SIB)
500
400
300
200
100
0
10
20
30
CONSECUTIVE 30 S INTERVALS

Figure 10 Results of Study 3 for Carl. A frequency distribution of Carl's SIB is shown in the top panel. A cumulative record of Carl's SIB is shown in the bottom panel.

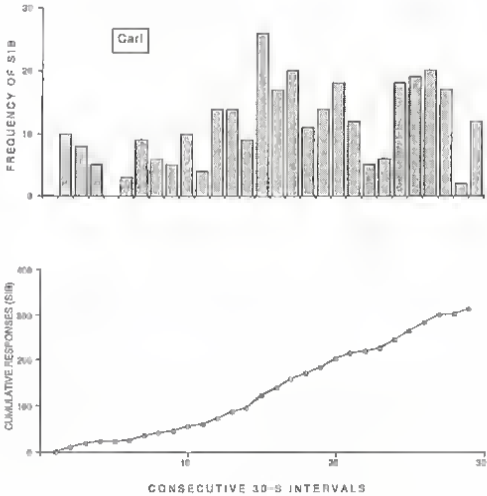
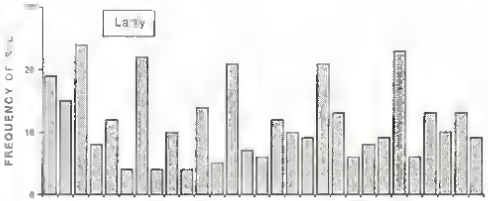

Carl
FREQUENCY OF SIB
CUMULATIVE RESPONSES (SIB)
CONSECUTIVE 30-S INTERVALS

Figure 11. Results of Study 3 for Larry. A frequency distribution of Larry's SIB is shown in the top panel. A cumulative record of Larry's SIB is shown in the bottom panel.


Lanny
FREQUENCY OF
20
10
0

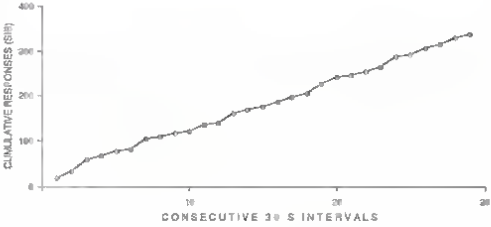
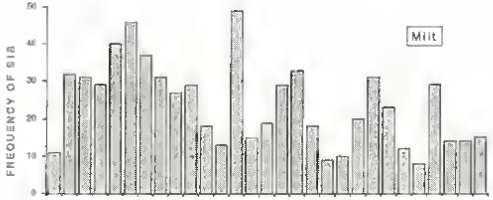
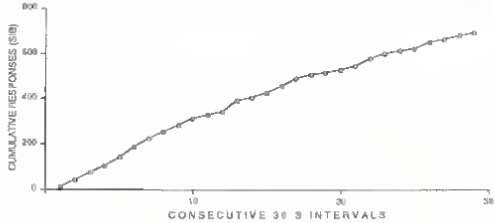

CUMULATIVE RESPONSES (SR)
400
300
200
100
0
10
20
30
CONSECUTIVE 30 S INTERVALS

Figure 12 Results of Study 3 for Milt. A frequency distribution of Milt's SIB is shown in the top panel. A cumulative record of Milt's SIB is shown in the bottom panel


Milt
FREQUENCY OF SIB


CUMULATIVE RESPONSES (SIB)
CONSECUTIVE 30 S INTERVALS

respectively). Milt's cumulative record is shown in the lower panel of Figure 12, and shows a very slight deceleration over the course of sessions.

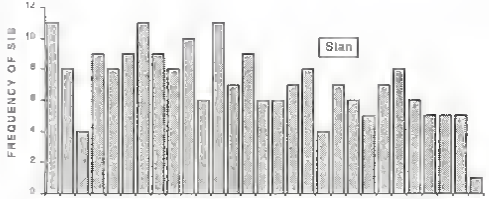
Stan's results are presented in Figure 13. The upper panel shows the number of responses recorded during successive 30-s intervals, summed over 15 sessions. These data show a gradual decrease in the frequency of SIB throughout the sessions. The mean frequency of SIB during the first 10 intervals of sessions was 8.7, and the mean frequency of SIB during the final 10 intervals of sessions was 5.9. Stan's cumulative record is shown in the lower panel of Figure 13, and a slight decelerating trend in SIB is seen in this graph.

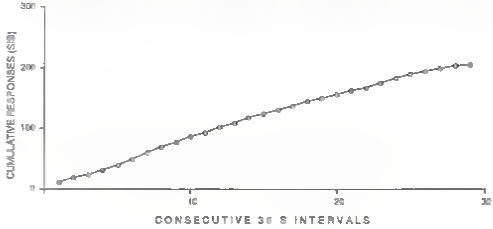
Discussion

Study 3 investigated the effects of session duration on SIB maintained by escape from task demands. Because subjects were able to escape all task trials, it is possible to infer that trends in responding during sessions may be related to the momentary effectiveness of trial termination during sessions. That is, differences in response rates during the course of demand sessions in which escape was always available (contingent on SIB) and all other variables were controlled (tasks were randomized, instructions constant, etc.) suggest that the reinforcing effect of trial termination was altered as a function of time, or of an unidentified temporally correlated variable.

The results of Study 3 showed several patterns of responding during sessions. Evelyn's and Landon's data revealed that their SIB accelerated during sessions, with most SIB occurring during intervals toward the end of sessions. Helen's and Carl's data also showed increasing trends; however, these trends were clearly less pronounced than those in Evelyn's and Landon's data. Larry's data showed no clear trends. Milt's and Stan's data showed slight decreasing trends over the duration of sessions. Thus, Study 3 showed that it is possible to observe clearly differentiated patterns in responding over time, even

Figure 13 Results of Study 3 for Stan. A frequency distribution of Stan's SIB is shown in the top panel. A cumulative record of Stan's SIB is shown in the bottom panel


FREQUENCY OF SIB
Stan


CUMULATIVE RESPONSES (SIB)
CONSECUTIVE 30 S INTERVALS

though the consequence determined to maintain SIB was available contingent upon that response at all times.

There are at least two general explanations for increasing trends in escape-maintained SIB during sessions. First, the duration of time during which trials are presented, or some other temporally related variable, may directly alter the reinforcing effectiveness of trial termination, such that trial termination becomes a more powerful reinforcer as the session progresses. Put simply, it may be aversive to be in a demand session for a long time. Similarly, the number of trials previously experienced (versus the length of time over which they were presented) may alter the reinforcing effects of trial termination for upcoming demands. Both of these specific cases represent examples in which an establishing operation is responsible for observed changes in behavior. Further, it is possible that each has unique establishing effects and may interact with the other to evoke SIB. Evelyn's and Landon's data, and to a lesser extent, Helen's and Carl's data are consistent with the account that time, or a temporally related variable such as the cumulative number of trials, established trial termination as an increasingly powerful reinforcer during sessions. Another possible account for accelerating SIB during sessions is that SIB comes under control of a motor escape contingency, in which termination of the session at 15 min provides adventitious reinforcement (escape) (Melbtz, Hineline, Whitehouse, & Laurence, 1983). According to this account, each session may be viewed as a single "trial" with a Fixed Interval 15 min (FI 15 min) schedule of reinforcement. Fixed interval schedules produce patterns of responding in which initially low rates accelerate as time to reinforcement decreases, producing a "scallop' pattern in cumulative records. Although Evelyn's and Landon's seem consistent with this account, another feature of this account is that the discrimination of session length is learned, and thus the scallop pattern should emerge over successive sessions, becoming more prominent as the condition progresses. Evelyn's session-by-session data did not show such a pattern, however, Landon's session

by-session data showed some evidence that the scallop pattern may have emerged over time. Thus, the exact process underlying accelerations in Landen's SIB during sessions is unclear.

Data for Helen and Carl suggest that temporal variables may have increasingly established trial termination as a reinforcer; however, somewhat inconsistent patterns in the distribution of responses across sessions temper this interpretation. Neither pattern is appropriately described as "scalloped," and so neither supports an adventitious reinforcement account of the slow accelerations seen in the data. Thus, Helen's and Carl's results may show a slightly increasing sensitivity to trial termination as a reinforcer during sessions; however, the data are not sufficiently clear to support a definitive interpretation.

Larry's data show an apparent insensitivity to session duration variables as establishing events. That is, Larry's SIB appeared equally likely to occur during virtually any interval of sessions.

Milt's and Stan's data show slight decreases SIB during sessions. At least two operations may result in decelerating data during sessions. First, initial moments of a session may have greater establishing effects relative to subsequent moments. Similarly, presentation of task demands may lessen the establishing properties of subsequent trials (i.e., a within session habituation effect). These accounts both appeal to establishing operations as an underlying process. An alternative account for such data is that brief periods of escape are not sufficiently powerful reinforcers to maintain SIB, and that escape behavior thus extinguishes. This account, however, is based upon a learning process that should result in the virtual elimination of SIB over successive sessions as a function of previous experience with (from the subject's perspective) the extinction contingency. Neither Milt's nor Stan's behavior showed such a general decrease, with Milt continuing to exhibit high rates of SIB through 11 sessions and Stan continuing to exhibit moderate rates of SIB through 15 sessions.

Although this study contained limitations that precluded definitive interpretations for several subjects, it may be possible to overcome such limitations in subsequent studies. For example, Landon's results, which were consistent with both the establishing operations and adventitious reinforcement accounts (i.e., his SIB increased during sessions, and this pattern became more prevalent across subsequent sessions), may have been clarified by varying unpredictably the length of sessions. In so doing, responding under the control of session termination would either have stabilized or (because no actual contingency would exist between SIB and session termination) disappeared. If, on the other hand, temporally related variables altered the reinforcing effectiveness of trial termination, SIB would have been positively correlated with session length, and the patterns observed in the current study would have maintained at similar session durations.

The different response patterns generated by the subjects in Study 3 indicate that sensitivity to time-in-session session as an establishing operation may be idiosyncratic. Thus, such information may be useful in the development of treatment plans. For example, individuals displaying patterns of responding similar to Evelyn's, in which responses almost never occurred early in sessions but increased dramatically in the final minutes in sessions, may benefit from brief, but more frequent training sessions, rather than a few extended training activities per day. If extended sessions were required, then a fading program, in which initial sessions are brief and session duration is slowly faded in, may suppress maladaptive behavior. Alternatively, for individuals whose escape responding is more prevalent in early moments of sessions, it may be helpful to limit the number of training activities conducted daily, and to arrange extended sessions for necessary activities. Thus, continued refinement of methods for determining the effects of time-in-session and related variables may provide useful information for the management of maladaptive behavior maintained by escape.

STUDY 4: EFFECTS OF THE RATE OF TASK TRIALS ON SIB

The rate at which task trials are presented may alter the reinforcing effectiveness of escape from task trials. Three effects of the rate of task presentation are possible. First, the rate of task presentation may be unrelated to the effectiveness of trial termination as a reinforcer. That is, the percentage of trials occasioning escape responses may be the same regardless of the rate at which trials are presented. Second, increasing the rate of task presentation may increase the reinforcing effectiveness of trial termination. That is, the percentage of trials occasioning escape responses may increase with increases in the rate of presentation of task trials. Third, increasing the rate of task presentation may decrease the reinforcing effectiveness of trial termination. That is, the percentage of trials occasioning escape responses may decrease with increases in the rate at which task trials are presented.

Only a few studies have reported effects of task-trial rate on problem behaviors. Carnine (1976) investigated the effects of task presentation rate on off-task behavior (walking around, moving chairs, jumping, blurting out, talking, ignoring the teacher, and other minor disruptions), correct answering, and participation (responding within 1 s of the teacher's cue to answer) of two "low achieving" first grade children. The experimenters presented reading tasks to students in a group format, and signaled children to respond in unison to each task. Trials began when the teacher presented a task, and ended when the subjects responded. Presentation rate was defined by pauses between trials, in the Slow condition the delay was 5 s or more, and in the Fast condition the delay was 1 s or less. Results indicated that fast presentation rates were associated with decreases in off task, and increases in participation and correct responding. The lower levels of off-task behaviors in

the Fast condition may have been due to variables other than a change in the reinforcing effectiveness of trial termination, however. First, it is unclear that off-task behaviors were maintained by escape from tasks, as no functional analyses were conducted. Second, escape was not contingent upon off-task behavior. Third, subject behaviors were recorded throughout the teaching session; thus, in the Slow condition, off-task that occurred during the 5 s pauses between trials would have been scored, but would not be indicative of an escape function. Rather, it is likely that these behaviors occurred during "breaks" between trials and were maintained by unknown consequences.

Several studies have incorporated various rates of demand presentation into treatment by fading in tasks (Pace et al., 1993; Pace et al., in press; Zarcone et al. in press; Zarcone et al, 1993), however, none provided a direct analysis of the effects of different rates of demand presentation as establishing operations. That is, none examined whether differences in task presentation schedules alter the reinforcing effectiveness of trial termination.

Study 4 compared the effects of two schedules of task presentation on the percentage of task trials that occasioned SIB.

Method

Stan, Olivia, Carl, Larry, and Helen participated in Study 4. Two conditions were conducted, a High-Rate condition in which trials were presented at a rate of 30 per session (i.e., Fixed Time 30s [FT 30s]), and a Low Rate condition in which trials were presented at a rate of 10 per session (i.e., Fixed Time 90s [FT 90s]). The experimental procedures previously described for the Demand condition were in effect throughout Study 4, with the exception of trial rate. As in Studies 1 and 3, subjects received several task demands during each 15-min session, taken from a pool of demands previously shown to evoke

SIB. SIB always resulted in escape from the current trial, and compliance produced verbal praise and withdrawal of tasks until the next scheduled trial. For Stan, Olivia, and Carl, the experimental conditions were presented in an A-B format, with the high-rate condition preceding the Low Rate condition. For Larry and Helen the experimental conditions were presented in a multielement format, in which conditions were rapidly alternated.

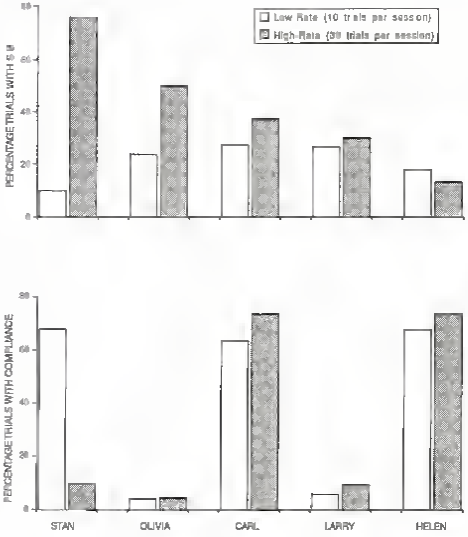
Data were collected on the percentage of task trials occasioning SIB. That is, trials terminated due to the occurrence of SIB were coded, and the number of trials with escape was summed across sessions for each subject. That number was then divided into the total number of task trials presented, yielding the percentage of task trials with SIB. This measure was used as an indicator of the effects of the rate of task trials on the establishing properties of those trials. It was not possible to evaluate the establishing properties of the two trial schedules by comparing rates of SIB because rates would be expected to correspond with those schedules even if no difference in establishing operations was present (i.e., a low rate of trials should produce a low rate of SIB, and a high rate of trials should produce a high rate of SIB).

Data also were collected on the percentage of task trials with compliance. That is, trials that occasioned compliance were coded, and the number of trials with compliance was summed across sessions for each person. That number was then divided into the total number of task trials presented, yielding the percentage of task trials with compliance. This result was used to determine the extent to which differences in percentages of trials escaped could be attributed to differences in reinforcement for compliance across conditions.

Results

Results of Study 4 are presented in Figure 14. Percentages of trials with SIB during the Low Rate condition (open bars) versus the High Rate condition (shaded bars) are

Figure 14 Results of Study 4 for Stan Olivia, Carl, Larry and Helen. The top panel shows percentages of trials with SIB during the Low Rate condition (open bars) versus the High Rate condition (shaded bars). The bottom panel shows percentages of trials with compliance during the Low Rate condition (open bars) versus the High Rate condition (shaded bars)


Low Rate (10 trials per session)
High-Rate (30 trials per session)
PERCENTAGE TRIALS WITH
PERCENTAGE TRIALS WITH COMPLIANCE
STAN
OLIVIA
CARL
LARRY
HELEN

shown in the top panel. Percentages of trials with compliance during each condition are presented in the bottom panel.

Stan's results show that trials in the Low Rate condition seldom occasioned SIB (10% of trials with SIB) but that trials in the High Rate condition often produced SIB (75.6% of trials with SIB). Percentages of compliance were higher in Low Rate versus High-Rate conditions (67.8% versus 9.7% of trials with compliance, respectively).

Olivia's data show similar, but less pronounced effects, with 23.8% of trials in the Low-Rate condition occasioning SIB and 49.6% of trials in the High-Rate condition occasioning SIB. Percentages of compliance were 3.9% in the Low Rate condition and 4.3% in the High Rate condition.

Carl's data showed 27.5% of trials in the Low-Rate condition with SIB and 37.1% of trials in the High Rate condition with SIB. Percentages of compliance were 63.3% in the Low-Rate condition and 73.6% in the High Rate condition.

Larry's data showed very little difference with respect to escape with 26.7% of trials occasioning SIB in the Low-Rate condition and 30% of trials in the High Rate condition occasioning SIB. Larry's percentages of compliance were 5.8% in the Low-Rate condition and 9.2% in the High-Rate condition.

Helen's data show a slight reversal in outcomes relative to other subjects. Although the difference in percentages of escape was small, trials in the Low Rate conditions were more likely to result in SIB (18% of trials with SIB) than were High-Rate trials (13.5% of trials with SIB). Percentages of compliance were 67.7% in the Low Rate condition and 73.7% in the High-Rate condition.

Discussion

Several outcomes for this assessment were possible. First, High Rate conditions may have produced higher percentages of trials with SIB than Low Rate conditions, with no differences in compliance, or higher percentages of compliance in High Rate conditions. Such results would suggest that high rates of demands increase the reinforcing effectiveness of task termination. Second, High-Rate conditions may have produced higher percentages of trials with SIB and lower percentages of trials with compliance relative to Low Rate conditions. Such results would suggest that the difference in percentages of trials with SIB may be related to differences in compliance percentages. Also, Low Rate conditions may have produced higher percentages of trials with SIB than High-Rate conditions, with no differences in compliance, or higher percentages of compliance in Low Rate conditions. Such results would suggest that low rates of demands increase the reinforcing effectiveness of escape from those tasks. If, however, higher percentages of trials with SIB in Low-Rate conditions were also associated with lower percentages of compliance, then rates of compliance may be responsible for the difference in percentages of trials with SIB. Finally, there may have been no difference or little difference in percentages of escape for Low-Rate versus High Rate conditions, suggesting an insensitivity to rate of trials as a variable altering the reinforcing effectiveness of trial termination.

Results of Study 4 show that the rate at which task trials are presented may affect escape behavior. The data for Stan, Olivia, and Carl show clear differences in percentages of trials escaped, with high rates of task presentation producing increases in the percentage of trials with SIB. The data for Larry show a slightly higher percentage of High-Rate trials with SIB, and Helen's data show a slightly higher percentage of Low Rate trials with SIB,

however, in neither case were differences sufficient to infer that escape behavior had been changed as a function of trial rate.

Interpretations of the data for some subjects must be cautious due to limitations in the experimental procedures. For Stan, Olivia, and Carl, the experimental design did not include reversals, which may have affected the results of the study. Because the Low Rate condition always followed the High Rate condition, it is possible that subjects learned to comply with task requests, resulting in lower percentages of trials with SIB in the Low Rate condition. Examination of compliance across conditions indicates that this may have occurred for Stan, whose data revealed a 58.1% difference in compliance between conditions, with low trial rates associated with the higher level of compliance. Thus, it is not possible to determine whether the difference in Stan's compliance was due to a learning effect or due to an unknown variable associated with the rate of trials. Percentages of compliance for Olivia and Carl showed only slight differences in compliance,with High-Rate conditions occasioning slightly higher compliance percentages. These data are consistent with an establishing operations account of increased percentages of trials with SIB in High-Rate conditions, because increases in reinforcement for compliance were not present (and thus, cannot account for lower percentages of trials with SIB) in the Low-Rate conditions. However, an improved experimental design utilizing reversals or a multielement format would permit more definitive interpretations by controlling for learning effects.

Larry's and Helen's data suggest that their behavior was relatively insensitive to the rate at which task trials were presented. Interestingly, these two subjects experienced the two experimental conditions in a multielement format, whereas Stan, Olivia, and Carl all experienced the conditions in an A-B design. One weakness of the multielement format is the potential confounding of effects of two or more rapidly alternating conditions (Ulman & Sulzer-Azaroff, 1975). Thus, it is possible that rapid alternation of very similar conditions

may produce poor differentiation of behavior due to inadequate schedule control or carryover effects

Future investigations of the effects of task trial rate on escape behavior might best utilize a reversal format (ABAB) in which each condition is replicated at least once following experience with the other This design minimizes both learning effects and potential problems due to interference among conditions.

Information resulting from an assessment of the establishing effects of task trial rate may be useful in the development of training routines and treatments for behavior problems maintained by trial termination If, for example, high rates of task presentation occasion higher levels of escape behavior, then it may be appropriate to arrange for training programs to be conducted at a slow pace, thus minimizing motivation for escape If it is necessary to present demands at higher rates, then methods for systematically fading in the frequency of demands may be indicated (e g , Pace et al., 1993)

GENERAL DISCUSSION

The current series of studies provides preliminary data on a general method for assessing establishing operations for behavior maintained by escape from task demands. The variables examined in these studies were the novelty of tasks, the time-course of sessions, and the rate of task-trial presentation. The results suggest that such variables may alter the effects of reinforcement in ways that may be idiosyncratic across individuals.

The general method described in the current experiment may be useful for identifying other antecedent variables with potential establishing effects. By maintaining a contingent relationship between behavior and its reinforcing consequence, it should be possible to investigate the establishing effects of a wide variety of variables. Given appropriate controls for confounding variables, changes in behavior may be attributed to manipulations of the establishing event. Using this general arrangement, potential variables for study may include task "effort," "complexity," motor requirements (i.e., gross- versus fine-motor tasks), and so on. Further, it may be possible to investigate the effects of antecedent variables in isolation and as compound events, to determine how such variables may interact to alter the functional properties of each. For example, it is possible that the effects of novel demands can be altered as a function of response effort (e.g., less effortful novel tasks may evoke less escape behavior than more effortful novel tasks). A determination of the functional properties of novel demands across different measures of effort may reveal such effects.

Another potential extension of the current method is in the assessment of establishing events for maladaptive behavior maintained by positive reinforcement. For example, by

maintaining a contingent relationship between SIB and attention, it may be possible to examine the effects of deprivation versus satiation of attention on behavior thus maintained. Additional variables, such as novel experimenters' time-in-session, and other antecedent events also may be assessed using this method. Again, it may be possible to conduct investigations into the differential effects of compound variables if the functional properties of the elements are known.

The possibility of using this method for assessing complex relationships among antecedent events and behavior suggests an incremental approach to the functional analysis of "context." That is, it may be possible to "build" a model of context experimentally, using elements with known functional properties. This approach offers an advantage over current models of context in that interpretations of the basic behavioral properties underlying changes in behavior may be made with increased confidence. Because most current research on contextual (or setting) variables investigates the effects of complex antecedents without assessing the function of the variables comprising these events, and because the maintaining consequences for target behaviors are often unknown, uncontrolled, or completely absent, it is rarely possible to conclude more than that behavior changed when context changed. That is, a structural (or correlational) relationship between some environmental event(s) and behavior has been shown. This can be useful information in a technical sense: a demonstration that a procedure modified the behavior of one (or more) individuals suggests that a similar procedure also may modify the behavior of others with similar problems. This approach to intervention may best be termed behavior "modification," in which procedures are applied in the relative absence of prescriptive information relating to known functional properties of the behavior targeted for change. A relationship between environmental events and behavior usually is apparent; however, the basic processes underlying behavior change are not

A more sound approach to the study of environmental effects on behavior is to identify incrementally the functional properties of events within the environment. Although it is tempting to propose elaborate constructs (e.g., setting events, behavioral fields, etc.) to account for complex behavior, a thorough account of behavior requires independent isolation and analysis of functional variables. If elaborate constructs are necessary to explain behavior, then they will arise from failures of simpler accounts to do so. Scientific parsimony dictates that phenomena be described using the fewest number of concepts necessary, and the science of behavior has not yet reached a point where we have attempted (much less failed) to account for behavior using established methods and concepts. Thus, it seems prudent (if somewhat painstaking) to pursue an understanding of complex behavior by building explanations based on elemental analyses, rather than to propose elaborate hypothetical constructs that do not contain, but ultimately require, explication based upon fundamental principles. One of the virtues of behavior analysis is a willingness to admit what we are not yet prepared to explain.

Superficially, it appears that an account of the functional properties of behavior may not be important from an applied perspective. Is it not enough to develop a set of procedures that often produce behavior change? The answer is an unequivocal "no." Without an understanding of the functional properties of behavior targeted for change, we have little basis for selecting from possible treatment procedures. We are left to sample procedures until we find success. Further, the reasons behind the success or failure of a particular procedure are obscured when the functional properties of behavior are unknown. Thus, if an initially successful procedure fails to maintain its effects, we know neither why the failure occurred nor how to effect repairs. From such ignorance the need to use default treatments (e.g., punishment) arises (Iwata, 1988).

An understanding of establishing operations in behavior disorders may be particularly important from an applied standpoint. If it is possible to manipulate directly

variables that motivate maladaptive behavior, then the negative side effects of consequence-based treatments such as extinction and punishment may be avoided. That is, manipulations of establishing operations represent a proactive approach to treatment, and thus reduce the necessity of programmed consequences to reduce maladaptive behavior. Methods to identify the functional properties of antecedent events may produce information that is important in developing and assessing the effectiveness of treatments based on establishing operations.

Although the current set of studies contains limitations that require cautious interpretation of some of the data, the results offer preliminary insight into variables that may alter the reinforcing effects of trial termination for individuals whose behavior is maintained by negative reinforcement. Perhaps more important, a generic method for the study of such variables is set forth, in which maintaining consequences remain intact during assessment of antecedent influences. With further refinement and extension, this method may prove useful for assessing a range of establishing events for behavior maintained by escape, and may be also be adaptable for assessing the establishing properties of antecedents to maladaptive behaviors maintained by contingencies other than escape. Finally, if this method is determined to be effective for assessing isolated establishing operations, then research into more complex antecedent events may proceed in a manner using sound scientific methodology, permitting eventual analysis of contextual variables in terms of basic behavioral processes.

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BIOGRAPHICAL SKETCH

I was born December 3, 1956 in Jacksonville, Illinois. I attended Illinois State University where I earned a Bachelor of Science degree in Psychology in 1980. I worked for several years in the field of developmental disabilities before enrolling at the University of Florida as a graduate student in psychology (experimental analysis of behavior) in 1988. I served as a teaching assistant and an instructor as part of my graduate training, and participated in research activities throughout graduate school. My graduate research has emphasized analysis and treatment of behavior disorders. Following graduation, I plan to pursue a career in behavior analysis, including teaching and research.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate in scope and quality as a dissertation for the degree of Doctor of Philosophy

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December, 1994

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